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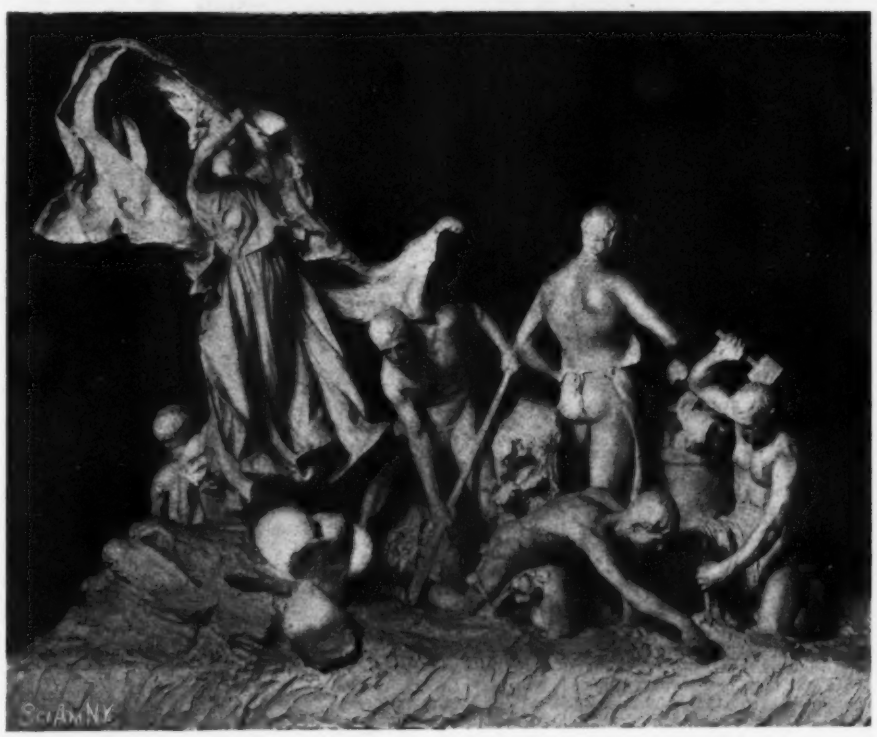
THE PAN-AMERICAN EXPOSITION.

THE idea of the Pan-American Exposition was to commemorate the achievements of the nineteenth century, to illustrate the progress and civilization of the nations of the western hemisphere, and to inaugurate a new era of social and commercial intercourse with the beginning of the new century. The selection of a site for an exposition is a most important one, and Buffalo is particularly well located for an exposition, for there are more people living within a day's journey of that city than of any other place in the western hemisphere. Within a circle whose radius is five hundred miles live one half the population of the United States and three-fourths of the population of Canada. Forty millions of people live within this circle. It is a great railroad center, and is readily accessible from two of the Great Lakes. In addition, it has Niagara within a few minutes' ride, which is in itself an attraction of the highest order.

The Pan-American idea is based on a broad brotherhood and closer union among the American nations, and an exposition to promote the idea held on any spot, in any of the Americas, would be sure of success. Naturally the first exposition of this kind should be held in the United States, and it is especially fortunate that Buffalo was selected, as it is so convenient to Canada. It was at first hoped to hold the Exposition two or three years earlier, and President McKinley, on August 26, 1897, drove the first stake for an exposition site on Cayuga Island, but the war with Spain brought the enterprise to a halt. After the war there was a reorganization of forces. Committees were appointed and Federal and State legislation secured. A popular subscription of over $1,500,000 was pledged by 11,000 citizens. Various available sites were canvassed by experts, and choice was made of a tract of land adjoining Delaware Park, to the north of the city; the most beautiful section of the park itself was also set aside to form a part of the grounds. The authorized capital of the Exposition Company was $2,500,000, and the authorized bond issue was for an equal amount. In addition the United States government appropriated $500,000 and New York State $300,000, so that the total available resources amounted to $5,800,000. In addition, various sums were appropriated by many States for their own buildings, Illinois appropriating $75,000, for example. Concessionaires also paid considerable sums for various privileges. The republics of South and Central America were also willing to contribute to the enterprise by the erection of government buildings.

The Exposition is readily reached by a number of street car lines and by frequent trains on the Belt Railroad, so that it can be reached in twenty minutes or half an hour from any



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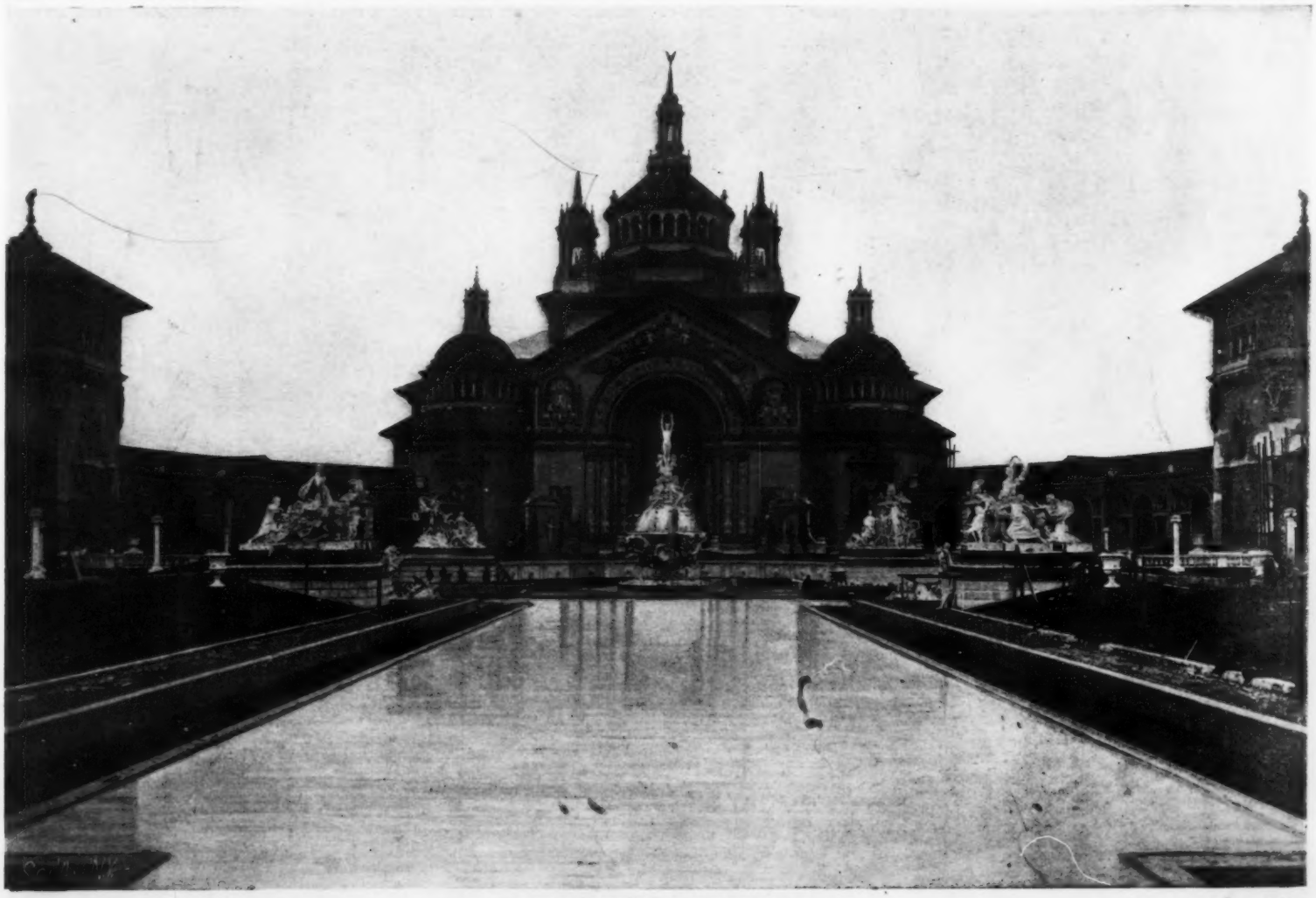
MINERAL WEALTH—BY CHARLES H. NIEHAUS.



HORTICULTURAL BUILDING.

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OFFICIAL OPENING OF THE PAN-AMERICAN EXPOSITION.

part of the city. The facilities are ample to deal with large crowds of people. Entrance to the grounds is obtained by seven gates, and passing through the turnstile we reach what has been called the "Rainbow City." Most of the great expositions have resembled each other in their architecture and landscape gardening, or have had many points of similarity. Chicago took the lead in 1893 when she built the great "White City" on the shores of Lake Michigan. A number of other small fairs have been held since this time, but they all resembled the Chicago prototype. The projectors of the Pan-American Exposition decided that they must have something which should not only be original, but which should be of the highest class, and as it was to be an American exposition, the motives should be largely American. There is, strictly speaking, no American style of architecture, except that used in our high buildings, and they are not at all adapted to exposition purposes. What was desired was an architecture which, while not primitive, should be in a sense indigenous to both North and South America, and which should symbolize the European conquest of the great part of the western hemisphere. The old mission buildings of the Southwest are familiar in all Latin America, and the massive walls, white or tinted, with heavy belfries, projecting roofs of red tile, and long arcaded corridors, seem to offer the keynote of the style to be adopted. Mission architecture or Spanish architecture adapted to the needs and the means of a strange, new world was the prevailing style adopted. This form of construction met the demands both of utility and sentiment, and although the buildings run the whole gamut of the architectural orders of combinations and modifications, yet it all comes into harmony, and the Spanish-American idea makes itself felt throughout.

The site was an excellent one. Its 350 acres include 133 of improved park lands adorned with smooth lawns, wooded knolls and a stream and beautiful lake spanned by fine bridges and gemmed with green islands. The general arrangement of the Exposition grounds is extremely simple. The area is approximately a rectangle, 3,000 by 5,000 feet, and in it are disposed the various structures, all of which are subordinate to the general effect. The principal entrance to the grounds, from an artistic point of view, is the Lincoln Park Gateway, although this entrance is not used to anything like the extent that some of the other entrances are, owing to the fact that it is not a street car or railway terminus. The first few minutes' walk is through Delaware Park, and the bridge connecting two parts of the lake is crossed, and passing the Life saving Station, the Approach is reached. Here are triumphal columns which lead to the Fore Court, which in turn leads to the Triumphal Bridge, an imposing structure designed by John M. Carrère. The four towers are a hundred feet high, and are surmounted by mounted standard bearers. Each of these sculptural groups is 30 feet in height. The cables connecting the piers and running north and south carry enormous festoons, shields, flags and coats-of-arms of the various Pan-American countries. The effect is very beautiful as they sway in the wind. On each side of the bridge are fountains composed of groups of rearing horses and figures which cluster about tall flagpoles. At this point the visitor gains his first sight of one of the most interesting features of the Exposition; this is the series of canals and lakes which surround the main group of buildings, making a delightful waterway for the gondola and electric launch. They are some two miles in length. From the Triumphal Bridge one obtains a superb view of the Exposition. To the right and left are Pergolas with bright awnings and climbing vines. These Pergolas make an architectural connection with two groups of buildings, the Mines, Horticulture and Graphic Arts Buildings on the left, while on the

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CHIEF RED CLOUD.

right are the three Government Buildings connected by arcades. Directly in front is the Esplanade, which is of noble proportions and is capable of accommodating 250,000 people. In the center of it are two bandstands, and on the right and left are Esplanade fountains. The Esplanade is terminated by the round-dome buildings devoted to the Temple of Music and Ethnology. These are in turn connected by colonnades with the Machinery and Transportation and Manufactures and Liberal Arts Buildings respectively. The space between the two groups of buildings is occupied by the Court of Fountains. Narrow malls separate the Electricity and Machinery Buildings and the Agriculture and Manufactures Buildings. The group is terminated by the Electric Tower which is the most salient feature of the Exposition. The main shaft of this edifice is 80 feet square at the base, and the torch of the statue which surmounts it—the Goddess of Light—is 409 feet above the ground. In the great niche cut into the front of the structure is a cascade composed of an upper and a lower fall. In a wide basin in front are forty-two water jets which fall in parabolic curves and concentrate at the niche. The sources of the jets are arranged in an arc of which the niche is the center, and the streams can be broken into sprays so that they will constitute a transparent and quivering sheet of water. On either side of the middle of the basin are groups of twenty-six vertical jets which send the water up to a height of fifty feet. Concentric with the sources of the parabolic jets are arranged ten powerful arc lights which serve to illuminate the fountain, colored glasses permitting of tinting them. Altogether the fountains in the grounds call for 35,000 gallons of water a minute, and of this amount the Electric Tower consumes 13,000 gallons. To the rear of the Electric Fountains are bandstands, the Propylæa and the Railway Terminal Station and Railway Exhibits. Such in brief is the outline of the Exposition, but there are a number of other and minor buildings scattered around various parts of the grounds.

The most talked-of feature of the Exposition is the use of color on the buildings, and the direction of it was confided to the care of Mr. C. Y. Turner, painter, of New York. The staff walls of the main buildings, especially in their more ornamental portions, have been finished in a great variety of color; now strong, bright, highly contrasting hues; again subdued and neutral; while the red roofs and Spanish tile treatment dominate the other colors. The ensemble furnishes a most brilliant picture. The whole group of buildings has been treated as one picture and the colors are made to harmonize, not only with one another, but with the foreground of grass, the water and the background of the sky. One idea which has been adopted, and which is a most interesting one, is not noticed by the visitor; that is, in the chromatic arrangement the stronger colors are on the buildings nearest the Triumphal Bridge, as, for example, the Ethnology Building, where, as we approach the Electric Tower, the colors become less and less crude until the Fountain itself is reached, where everything is an ivory white, delicate green and gold, thus symbolizing the triumph of intellect over mere brute force. Thus the colors on the Ethnology Building are strong, because it contains stone axes, etc.; while electricity may be regarded as a great, perhaps the greatest, conquest of nature. Fully as impressive as this color scheme is the sculptural adornment of the grounds. There is a great wealth of statuary, and the individual groups have a high degree of artistic merit. Every eminent sculptor in America is represented, and all have worked with one end in view, which was to comprise in a sequence an embodiment of the various ideas associated with an American exposition, among them being the note of welcome, the recognition of State and national dignity, the natural wealth of the country and the prowess of man's inventiveness and labor. This is seen in the Triumphal Bridge. From its great

UNITED STATES GOVERNMENT BUILDING.

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piers on suspended cables are hung the shields decorated with the flags and coats-of-arms of the various Pan-American countries, as already stated.

For the landscape gardening there is nothing but praise. The little lagoons and mirror lake afford an excellent opportunity for display. The Court of Lilies and the Court of Cypresses are also very beautiful, and the decoration of the malls is most attractive.

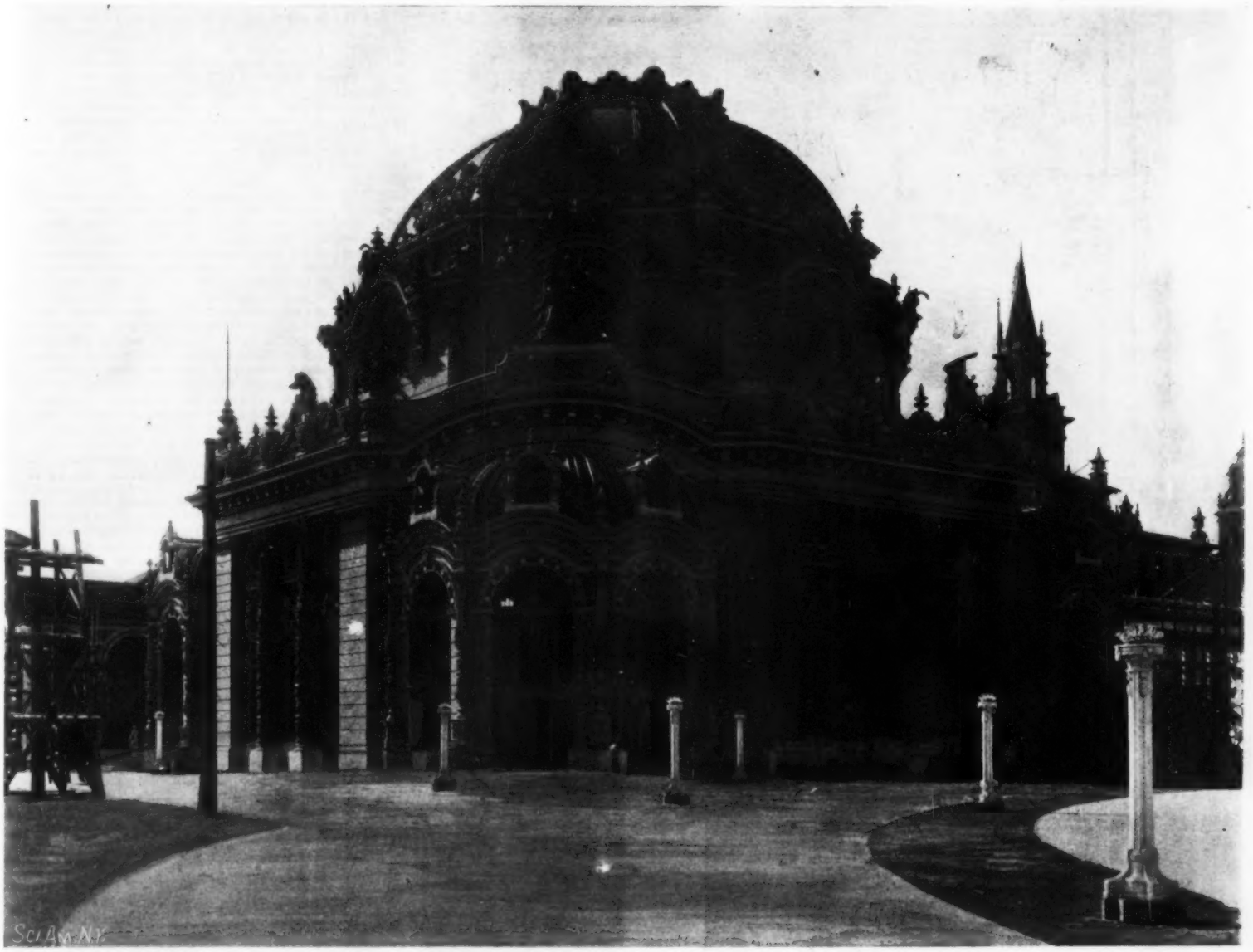
The Manufactures and Liberal Arts Building measures 500 x 350 feet, and was designed by Shepley, Rutan & Coolidge. It is surrounded by a portico 15 feet wide. On the corners and in the center of the façade are towers crowned with domes.

Most of the principal manufacturing concerns in the country are represented in this building as far as their goods come within the scope of this particular division.

The Machinery and Transportation Building was designed by Green & Wicks. It occupies a space 500 x 350 feet, and is in the form of a hollow square, and the interior court measures 100 x 200 feet, where the pumping station for the Exposition is located. The building is a splendid example of the Spanish Renaissance. A portion of the Transportation exhibit is installed in this building, but the cars and locomotives are in a building back of the Propylæa, which is used as a Terminal Station and also for heavy railway exhibits. In the latter building are a number of the finest types of locomotives, including a Baldwin locomotive equipped with a Vanderbilt boiler and also a Vanderbilt tender. The old DeWitt Clinton engine and train is also on exhibition. The locomotive exhibit is one of the best in the entire exhibition. The Agricultural Building was built by Shepley, Rutan & Coolidge. It is 500 feet long and 150 feet wide; the color scheme is light yellow and red. It matches the Electricity Building, which is across the Tower basin, in the architectural scheme. It was designed by Green & Wicks, and is 500 feet long and 150 feet wide. In the northwestern corner is the Niagara Falls Transformer plant, where the power transmitted from the cataract is stepped down to voltages which are possible to use. The electrical exhibits are most creditable, and the principal firms in the United States are represented. The Electrical Tower has already been described. The Stadium seats 12,000, is 840 feet long and 400 feet wide. Sports of all kinds are to be provided. It is designed by Walter Cook, of Boston, and is an exceedingly beautiful structure.

The Temple of Music somewhat resembles the Ethnology Building, and both face the Esplanade. The former is a square building, but is given a circular effect by reason of the arched entrances. The dome rises 130 feet above the main floor, and the building measures 150 x 150, and was designed by August Esenwein, of Buffalo, N. Y. It provides an auditorium capable of seating 2,200 people, and it contains one of the largest pipe-organs ever built in the United States. The building will be used for concerts and musical festivals. The Ethnology Building is circular in form, the diameter being 150 feet. The dome is covered with red tile and the effect is excellent, notwithstanding the fact that color is used profusely in this building. It was designed by George Cary, of Buffalo, and contains many interesting exhibits. The Esplanade is bounded east and west by two groups of buildings arranged in the form of hemicycles. Nearest the Temple of Music is a building devoted to the Graphic Arts. This is connected with the Horticultural Building by a curved conservatory, and another curved conservatory connects the Horticultural Building with the building devoted to Mines. R. S. Stearns, of Boston, was the architect of the entire group of buildings. The Horticultural Building is surmounted with a lantern roof which rises to a height of 240 feet. The exhibition of fruits is a most important one, and in the conservatories are good examples of hothouse plants. The building devoted to Mines contains one of the most interesting exhibits in the entire exhibition, and includes raw materials, mining machinery and the finished products. Very decorative Pergolas shade the walk to the Government Building, the only break in them being where the Esplanade ends to give an approach to the Triumphal Bridge.

The United States Government Buildings, three in number, connected by arcades, were designed under the direction of the Supervising Architect of the Treasury Department, Mr. J. K. Taylor, and the expense to the government of the buildings and exhibits was $500,000. The government exhibit is easily the most interesting in the grounds, and was practically the first installed. There is material for several days' study in this most attractive group of buildings, and the various departments and bureaus of the government have nobly responded to the request of the Exposition authorities for an adequate exhibition. The Fisheries Building contains a large number of aquarium tanks, and one entire pavilion is given up to the work of the United States Fish Commission. The War and Navy Departments have most interesting exhibits of ordnance, armor, models of ships, historical groups showing uniforms. The Marine Hospital Service has a small hospital installed, and courteous attendants are always ready to give explanations. The Post Office Department shows how the mail is carried in all parts of our country and territories. Various stamps are shown, and the Post Office Museum has been called upon for interesting exhibits showing articles sent through the mail, etc. The Treasury Department shows examples of bills of all kinds, and how money is minted. The Lighthouse Service is adequately represented by two large lamps, a lighthouse in the center of the building, fog signals, etc. A siren is frequently operated. The Department of State loans a large number of interesting portraits, documents and historical curiosities, including Washington's and Jackson's swords. The Patent Office is represented by a large number of interesting models and a number of full-sized machines of American invention, such as the linotype, the monotype, the telautograph, etc., giving an idea of some of the highest developments of American inventive skill. The Smithsonian Institution makes a most interesting exhibit, including ethnological groups, models of extinct animals, and examples of the various collections in the Smithsonian Institution proper and the United States National Museum. The Department of Agriculture occupies a large space, and each division of the Department has made a most interesting and creditable showing. Many of the operations of this important branch of the government service are shown in operation; for instance, pork is actually being inspected under the microscope. Many of the less known but very important bureaus, such as the Bureau of Education, the Geological Survey and the Coast and Geodetic Survey, are adequately represented, and there is a fully equipped Weather Bureau observation station. Careful examination of the government collections will be a liberal education to many thousands who visit the Exposition. Between the Government Building and Canal are shown a number of pieces of ordnance, including disappearing gun carriages, etc. There is a permanent military camp on the grounds, and the soldiers drill daily.



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TEMPLE OF MUSIC—WHERE THE DEDICATORY OPENING EXERCISES WERE HELD.

The space between the Government Building and the large lake is taken up by a number of State buildings and the buildings of foreign countries, including Honduras, Cuba, Chili, Mexico, Guatemala, the Dominican Republic and Ecuador. The Ordnance Buildings are in two sections, and are about the best lighted on the grounds. Between them is a large model of a Gruson turret. A few steps from the Ordnance Building is the Art Gallery, a temporary structure. It was built after it was found that the great Albright Gallery could not be finished in time. The result is that the opening of this building has been greatly delayed. On the shore of the lake is the United States Life-Saving Station, fully equipped with boats, mortars, etc., and a stand is provided so that visitors may see the evolutions. The New York State Building is near the Elmwood Gate, and is a permanent structure, being built of granite. After the Exposition it will be turned over to the Buffalo Historical Society. The architect was George Cary, of Buffalo, and the cost was $375,000. Passing the Graphic Arts workshop, where printing machinery is exhibited, we reach the Midway, which contains all of the amusement features of the Exposition. It is a single street, which curves almost constantly, giving pleasant vistas. It ends near the Electric Tower. The first concession is the Indian Congress, with forty-

two tribes, which is well attended by visitors. Then come Jerusalem, the Ostrich Farm, Bostock's Zoological Arena, while on the other side is Venice in America, which is built around a branch of one of the canals. This is a German village of the old time. Next comes the Philippine Village, the War Panorama, Greenland and other amusements. The Beautiful Orient is a very large concession, which terminates at one corner where he wishes to go. The Scenic Railway and the Infant Incubator bring us to the West Amherst Gate, where large numbers of visitors enter. The Midway crosses a wide street and Alt Nürnberg is reached.

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GROUP OF HORSES BY FREDERICK MACMONNIES.

It is one of the most interesting and beautiful of all of the concessions on the Midway. The Japanese Village contains theaters, bazars, etc., and in front are many jinrickshas, which carry the visitor anywhere in the grounds. It is filled with booths, theaters, etc., and here one may ride upon camels, donkeys and elephants. The processions are very entertaining. The Topsy-Turvy House, on the other side of the way, attracts many visitors, the entire house being upside down. The African Village, a Trip to the Moon, Streets of Mexico, Glass Factory, the Eskimo Village and other amusements end this most interesting and well-patronized street of shows. Scattered around the grounds are the Service Building, the hospital, Acetylene Building, Mission Building, Dairy Building, the Building of Canada, Forestry Building, Indian Mound, etc.

The Exposition is beautiful in the daytime, but at night the effect is indescribable. The arc light is banished except for the interior of buildings and for lighting the very edge of the grounds. The use of incandescent lights results in obtaining marvelous effects which cannot be produced in any other way. The general lighting of the grounds is effected by 1,500 posts, the shorter ones being 8½ feet high and surmounted by a cluster of bulbs; the taller posts have lamps on their sides as well as on the top. The number of lamps varies from twenty-five to one hundred, diffusing the light most admirably. Incandescent lights are used in profusion all over the main buildings, serving to pick out the architectural features. The work has been done so cleverly that wonderful effects are produced. There has been no attempt made to economize on the lighting, and the end fully justifies the expense, for the night effects are well worth a trip of fifteen hundred miles to see. By means of "dimmers" the brilliancy of the incandescent light is absolutely controlled, so that the gradual increase in lighting almost reminds one of dawn. The Electrical Tower, which is lighted by thousands of lamps, is naturally the most impressive feature of the night display, and when taken in connection with the fountain produces a never-to-be-forgotten impression.

In order to obtain the vast amount of current needed for electric lighting, of course a large power plant is required. There are three power plants at the Exposition. One is devoted chiefly to exterior decorative electrical effects; the second to power for service particularly intended for the use of exhibitors, and the third largely to pumping machinery for the operation of the various fountains. The first plant is entirely electrical, using high-tension current transmitted from Niagara. The use of a 25-cycle current for lighting lamps of eight-candle power is a decided innovation. The current is stepped down from 11,000 to 1,800 volts by nineteen transformers. The transformers are air cooled by means of centrifugal blowers. All this electrical machinery is in a fireproof vault. The second power plant is at the northwest corner of the grounds, and occupies a building 170x200 feet. There are nineteen boilers in all, and all are connected for burning natural gas. Sidings are provided for coal delivery, and a considerable supply of coal is kept on hand in case there is any failure of the gas. The steam pressure is 110 pounds, and the boilers are all provided with an induced draft apparatus. There are at present twelve steam engines in the building, driving electrical machinery by belts. In one of the four corners of the building are located the fire pumps, which are placed in a fireproof room. The plant in the center of Machinery and Transportation Building oc-

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POWER—BY AUGUSTUS LUKEMAN.

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MOUNTED STANDARD BEARER FOR BRIDGE—BY BITTER.

cupies the Court. There are twelve rotary pumps and a number of electric generating units. The boiler plant for the steam machinery in the Machinery Building is located in a separate building across the canal from it, and here are installed four Climax boilers, each of 500 horse power, burning natural gas.

SIGNALING TO MARS.

By SIR ROBERT BALL, F.R.S., in The Pall Mall Magazine.

I REMEMBER an occasion when the scientific world received a veritable "message from Mars," which excited the liveliest interest and astonishment. I am not now referring to the admirable play which we have all enjoyed, and whose title is expressed by the words just written; I am thinking of the meeting of the British Association which was held at Plymouth in the year 1877. This particular meeting, otherwise memorable from the circumstance that the marvelous instrument which we know as the telephone was then first made known to some of us, was by a singular coincidence the occasion on which one of the most striking astronomical discoveries of the century was first announced on this side of the Atlantic.

It was on August 11, 1877, that Prof. Asaph Hall, using the great refracting telescope in the observatory of Washington, discovered two minute satellites revolving about the planet Mars. Having taken another couple of nights to verify and complete his observations, he dispatched the telegram to Europe which was read at the British Association.

Many of us will remember the keen interest which this discovery excited. Had not previous great observers, including even Sir William Herschel himself, toiled, yet toiled ineffectually, to discover moons circling about this planet? Had not Tennyson, assured of the absence of satellites, spoken of the "moonless Mars"? It was reserved for the distinguished American astronomer, on the occasion we have mentioned, to be successful where his predecessors, less fortunate in their instruments and opportunities, had failed. If Prof. Hall had found even a single moon attendant on the ruddy planet, the discovery would have rendered his name forever famous in the annals of great observers. But his industry and skill met with a far more splendid reward; he discovered a second moon, and he pointed out to us the extraordinarily rapid movement of this inner satellite, which in three or four hours had moved from one side of the planet to the other. Nay, further, he was able to announce, even in the earliest days of his discovery, one of the great facts which these satellites disclose—he was able to tell us the weight of the planet Mars. This was of much importance, because the weight of a planet is an astronomical element about which there is always some uncertainty unless a satellite belonging to the planet can be made to give its definite pronouncement on the subject.

My reason in now referring to this matter of somewhat ancient history is to call attention to the date when the discovery was made. I should not perhaps say the date—I should rather say the month of the year. Asaph Hall's famous observation was made in August; and this is a fact which all who desire to see wonderful sights in Mars should lay to heart. They need never expect to obtain very attentive hearing from the astronomical world unless they are able to say their observations of the planet have been made in or about the month of August. Do not, please, let it be inferred from this statement that Mars is in a favorable position for observation in August of every year. This is, indeed, by no means the case. For example, Mars is not at the present moment in a really good position for observation; but next August it cannot be observed at all. Perhaps a few words of explanation will be necessary.

The earth and Mars and the sun come into line, with the earth between the two other bodies, once every two years and two months, or, to be more accurate, once every seven hundred and eighty days. When this is the case, Mars is said to be in opposition, and comes on the meridian at midnight. The planet is then in general much nearer to us than when he occupies any other position. If the orbits of the earth and of Mars were each exact circles, then the distance between Mars and the earth at each opposition would of course be always the same; and accordingly every two years and two months the planet would be in a good position for observing, and every one of these periods of good seeing would be equally advantageous with every other. But the tracks of the earth and of Mars are ellipses, not circles. Mars, in fact, departs so considerably from a circle that the distance from the earth to the planet at the time of opposition is in some cases twice as great as it is at other times. We know, of course, that if the distance of an object be doubled, the apparent size it presents is reduced to one-fourth, and consequently the features of Mars are seen four times as well during favorable oppositions as they are at unfavorable.

We thus obtain a guide as to the occasions on which the planet can be seen to the greatest possible advantage. The point in the earth's track which approaches most closely to the orbit of Mars is that which our earth occupies on August 26 in each year. On that particular day the earth passes between the sun and that point of the heavens in which Mars must be situated when he is nearest to the sun. In like manner, on February 22 in each year the earth passes between the sun and that point in the heavens in which Mars must be situated when he is at the greatest distance from the sun. We can now readily obtain the principles which will guide us in determining whether an opposition is, or is not, favorable to the study of the features of the planet. If it should happen that the opposition occurred actually on August 26, then Mars would be at the best possible position, and as near as it can come to the earth under any possible circumstances. If, on the other hand, the opposition should happen to take place on February 22, it would then be about as unfavorable as possible; for if the opposition happened at any other time of the year, the earth and the planet would be nearer together. We thus see that we have by the date alone a very fair test as to the excellence of any opposition of Mars for the purpose of a minute scrutiny of its surface. The nearer that date is to August 26 the better the opportunity, while the nearer that date is to February 22 the worse the opportunity.

For an opposition of Mars to take place at the most favorable time is a somewhat rare occurrence. It did, however, happen in 1877, when the opposition occurred on September 5, which was only ten days after the best conceivable date. It was the knowledge of this circumstance which induced Prof. Asaph Hall to take advantage of this exceptional opportunity, and to undertake that careful search for the satellites of Mars which was crowned with such remarkable success. Those of us who remember the appearance of Mars as a glorious ruddy orb in the autumn of 1877 will easily appreciate the significance of an opposition which occurred at the right time. We had another fairly good opposition in 1892, and there will be another in 1909.

I have introduced this little discussion for the purpose of explaining the remark that astronomers never expect any startling discoveries to be made about Mars, its satellites, or its markings, unless those discoveries are made in either August or September. I hope I have made it clear that we do not mean that such discoveries may be looked for every August and September; but it is certainly true that the conditions of observations cannot, from the nature of things, be exceptionally favorable unless in the two months mentioned.

This consideration finds its significance in connection with the paragraphs which have been going the round of the papers within the last few weeks as to certain alleged remarkable phenomena presented by this planet. Every astronomer who reads these statements, and is asked to believe that strange manifestations are apparent from this neighboring world, will at once say that, as such things were not seen when the opposition was really favorable, it is in the highest degree unlikely that they are to be seen now, when the opposition is about as bad as it can be. If these wonderful things had veritable existence, it is not in January or February that we should be reading of them; for, as already remarked, in such months as these we can never expect important observations to be made of Mars. No one who has ever looked at the glory of that planet in an August or September opposition, and its comparative feebleness when the opposition occurs in less favored months, will hesitate for a moment in viewing with very grave doubts any statements of alleged signs in the planet at the present time. I do not, indeed, go so far as to say that it is absolutely impossible for a discovery to be made about the globe of Mars at a February opposition, but the improbability of such an achievement is so exceedingly great that an unusual amount of testimony of the very strongest kind would be required to outweigh the presumption against it.

For this reason alone, even if there were no many others, astronomers attach no importance whatever to certain statements about Mars which have recently obtained considerable circulation. Whether there are inhabitants on that planet, we have not the slightest idea. Even if there are inhabitants, it would be extremely doubtful whether they are conscious of the existence of this earth, or feel any desire to communicate with us. But we may be certain that if there are inhabitants on Mars, and if they have been so ill advised as to have chosen the present time for making efforts to cause some demonstration which shall be perceptible to this earth, then their astronomical knowledge must be in a deplorable condition. They have chosen as the occasion for such efforts the very worst possible opposition. If the Martians are intelligent, they ought to know that a signal, to be perceptible two miles off, has to be four times as big as a signal perceptible one mile off, and that consequently they would be making an utterly foolish waste of their powers if they attempted any communications at a time so inappropriate as the present.

These considerations may perhaps help to dispose of the recent statements regarding Mars which have obtained wide circulation, though we may be glad to think that the credence attached to them seems generally not greater than they deserve. But, as the discussion of possible Martian signals recurs from time to time, it may be worth while to recall a few of the conditions bearing on the question.

The distance of Mars from the sun varies. It is sometimes as much as 153,000,000 miles, and it is sometimes as low as 127,000,000 miles. The track that the earth follows is much more nearly circular than is the track of Mars, but still there is an appreciable change between the distances of the earth from the sun at the different seasons. The actual distance between the two bodies is sometimes as great as 93,500,000 miles, and sometimes as small as 90,500,000 miles. A very little consideration of these figures will show how the very best possible position of Mars is to be obtained. As the track of the earth lies far inside that of Mars, it is obviously essential that when we come closest to the planet its distance from the sun should be at its lowest point—that is to say, at 127,000,000 miles. On the other hand, the earth should then stretch out as far as possible to meet Mars; but it can never stretch more than 93,500,000 miles from the sun, and consequently even under the very most favorable circumstances, which can, in fact, never be quite realized, the distance between the earth and Mars cannot be under 33,500,000 miles. It may, indeed, be said that 35,000,000 miles is nearly the lowest value to which the distance can decline under the present conditions of the orbits, and this can only occur when the opposition takes place close to August 26. We may mention that when the first satellite of Mars was discovered by Prof. Hall, on August 17, 1877, the distance from the planet to the earth was then 36,000,000 miles, which was still a million miles over the lowest distance to which it could sink with the concurrence of the best conditions. The question then arises as to the kind of signal which could be transmitted across a distance of 35,000,000 miles. Here again it is necessary for me to go into a few details.

A man standing on a hill a mile distant is not a

ON THE MIDWAY. Copyrighted 1901 by C. D. Arnold.

large object, but yet he is big enough to be perceptible—that is to say, the little image which he makes on the retina is sufficient to excite a distinct impression. Without any optical assistance, however, such as might be afforded by a binocular or a telescope, it would require very sharp vision to make out the signals that a man was transmitting to you from that distance. We are told by Sir Redvers Buller that the singularly acute vision of the Boers gave them certain relative advantages in their marksmanship in the early stages of the war; but even with the keenest vision ever given to a man a human being two or three miles off would not be a very distinct object to an observer who had no telescopic aid.

Let us now consider what help a telescope gives. There is an approximate rule which we may employ for the purpose of explaining the power of the telescope for such purposes as the present. It is not exactly the magnifying power of the instrument which is involved. The magnifying power depends on the eyepiece that is used, and admits of practically indefinite increase; but there is no advantage gained in pushing the magnifying power beyond a certain point, which depends on the aperture of the telescope. With every increase of magnifying power the brightness of the image is necessarily diminished. Unless, therefore, the telescope employed is sufficiently large to supply the image with the necessary quantity of light, any gain from the enlargement of the image may be more than neutralized by its faintness.

An estimate of the efficiency of the telescope for a purpose of this sort is given by what is called the "space penetrating" power of the instrument. We may measure this conveniently by taking the diameter of the object-glass and comparing it with the pupil of the eye. For instance, in a very fine and large telescope, the diameter of the object-glass may be a hundred times as much as the diameter of the pupil. In such a case we may say that the telescope has a space-penetrating power of a hundred—in other words, an object just visible to the naked eye would be still visible in such an instrument if it were borne to a hundred times its distance. If, therefore, making the most extreme supposition, we set down three miles as the limiting distance with which a man could be discerned with the unaided eye, we should have three hundred miles as a major limit to the distance at which he could be discerned with the most powerful telescope, even if all atmospheric interferences and other sources of loss could be avoided.

This simple consideration shows how idle it is to expect that objects would be visible on the heavenly bodies unless those objects had dimensions altogether greater than any we can associate with the operations of human endeavor. Take, for instance, the case of the moon, which is only 240,000 miles away from us. A man placed upon the moon would be necessarily totally invisible, even in our best telescopes, for we have seen that three hundred miles would be certainly the very utmost limit at which an object the size of a man could be discerned, and yet the moon is eight hundred times as far as this limit. You might as well expect to be able to see with the naked eye a single bee at a distance of ten miles as expect to see on the moon an object the size of a man, even with the biggest telescope. In fact, to use an illustration that I have given elsewhere, an object on the moon which was just large enough to be discernible with the help of one of our most powerful telescopes would have to be at least as great as St. Paul's Cathedral. Even then it must be remembered that we should not be able with any telescope whatever to distinguish the details of the object. It would only be recognized sufficiently to be indicated by a touch with the point of a pencil in making a sketch of the moon.

It is now a matter of simple proportion to find what the dimensions of the signals would have to be so that, if made on the planet Mars, they should be visible to us who live on the earth. We have seen that under the most favorable circumstances Mars must be nearly 35,000,000 miles from us. In other words, we infer that under no combination of circumstances can Mars approach us closer than about one hundred and fifty times the present distance from the earth to the moon. To see, therefore, an object on Mars, even with the best telescope that was ever constructed, that object must have dimensions on a scale one hundred and fifty times as great as the smallest object visible in the moon with the help of the same instruments. We have seen that a building as big as St. Paul's Cathedral on our satellite would about represent the size of the smallest visible object on the moon; we therefore infer that a building would have to be one hundred and fifty times as long and one hundred and fifty times as broad as St. Paul's to be discernible as the smallest point on Mars.

Assuming that there were inhabitants of Mars who were desirous of making signals to the earth by the waving of a flag, that flag would hardly be distinct enough for such a purpose unless it were ten times as long as the smallest visible point, and had breadth in proportion. We are thus led to the conclusion that a flag, say some three hundred miles long and two hundred miles broad, or perhaps about as large as Ireland, would be necessary for the purpose. If we could imagine a flag of these colossal dimensions on a flag pole, say five hundred miles long, and if the Martians availed themselves of the next favorable opposition, say in 1909, to make arrangements for waving this colossal flag to and fro, and if some of our most skillful astronomers, provided with the very largest and most perfect telescopes, and situated on the loftiest mountains on which observatories have ever been placed, were to be studying the surface of Mars, they might, I grant, perceive the waving of the flag, and might possibly be able to receive certain indications therefrom. But it would be of no use for the Martians to make this attempt at the present opposition. A flag the size of Ireland would be quite too small under existing conditions. Even if the flag were as large as the United Kingdom, it would not be sufficient.

I think this illustration alone will suffice to show the absurdity of the notion—if, indeed, it was ever seriously entertained—that the inhabitants of this earth can ever exchange intelligent signals with the inhabitants of Mars. But it is asked whether the inhabitants of Mars, disdaining altogether the use of gross material signals like those of waving flags, may not be successful with signals of some other type? May they not, for instance, employ some more refined process in which an adaptation suggested by that blessed word "electricity" may be available for the purpose? He would certainly be rash who now attempted to indicate the limits of what electricity may do for us in the future so far as this earth is concerned. We now talk familiarly with its aid between London and Paris; we expect before long to be able to hold a conversation with our friends in Rome. We are assured that we shall have ere long a telephone exchange by which the various capitals of Europe will be placed within conversing reach of each other.

It is, however, the telegraphy without wires that we think of in the present connection. That beautiful invention with which the name of Marconi is associated has accomplished feats which transcend anything that could have been dreamed of a few years ago. When Herz made his famous experiments, in which he succeeded in transmitting electro-magnetic waves a few feet, he could hardly have realized the recent development of his great discovery. It is now possible for the master of a ship at sea to communicate with another ship far below the horizon, and, indeed, fifty miles away. Valuable lives have been already saved by the marine application of this wireless telegraphy. Who shall say what limits are to be placed to the developments of this most marvelous process for utilizing the vibrations of the ether? I do not know whether Signor Marconi himself entertains the hope that it will ever be possible to transmit messages across the Atlantic by his admirable method. Let us, however, assume for a moment that such a vast extension of wireless telegraphy is conceivable. Let us even assume that the whole of our earth is to be included within the area over which the wireless telegraph signals would in time be extended. Yet I think we shall find that even if this degree of success, at present hardly to be anticipated, were achieved, we should still be hopelessly, if not quite immeasurably, distant from any rational prospect of success in transmitting appreciable electro-magnetic waves across the space between the earth and Mars.

It is essential to observe the fundamental difference between the transmission of a signal along the wire in the case of ordinary telegraphy and the transmission of a signal in the case of the wireless telegraphy. In the former case, as the message travels along the wire, or perhaps I ought to say, more accurately, through the ether in the wire and in its vicinity, it experiences no losses beyond those which are incident to the resistance of the wire and the leakage *en route*. The amounts of these losses are simply proportional to the length of the journey; these losses may be made so low that the wonderful achievements of cable telegraphy and the telephone have been rendered possible; this is at least a sufficiently precise statement of the facts for our present purpose. But the case is totally different when a message is being transmitted through space by wireless telegraphy. The message clearly emanates in this case not along one particular direction, as in wire telegraphy, but is diffused in every direction. The undulations in the ether from the wireless telegraphic apparatus are dispersed like the radiance from the sun in heaven, which spreads over an ever-widening sphere; they are not limited to one narrow prescribed course, and consequently their effectiveness declines as the distance increases much more rapidly than does the intensity of the electric current transmitted along a wire. To use the ordinary expression, the intensity of an effect spreading in all directions decreases inversely as the square of the distance. The light from the sun is reduced to a fourth when the distance is doubled; it is reduced to a hundredth when the distance is increased tenfold. In like manner the intensity of the undulations from the Marconi signaling apparatus decreases with the square of the distance, if not indeed in a ratio higher still. It is, however, still to be hoped that success in concentrating the waves in a particular direction may be attained in some degree. If this could be done, the figures now given might need some alteration, though none which would affect the validity of the conclusion aimed at.

Let us suppose that the signaling power of wireless telegraphy had been advanced to such a perfection that it was possible to transmit a signal across a distance of eight thousand miles—that is to say, across a distance equal to the diameter of the earth. I think it will be admitted that this is a very liberal supposition. The moon is, however, at a distance of about thirty times the earth's diameter, and therefore, even supposing that Marconi's waves could be sent across the earth's diameter, yet to be appreciable at the distance of the moon, which is thirty times greater, the intensity of those waves would have to be not merely thirty times, but thirty times thirty—that is, the efficiency must be nine hundred times as great as I have supposed. In other words, even if the whole earth were brought within the domain of wireless telegraphy, the system would still have to be improved nine hundred times as much again before the moon could also be brought within the sphere of influence.

And now let us apply this reasoning to Mars. I have shown that at its very closest approach Mars must still be some 35,000,000 miles from our earth—that is to say, even under the most favorable circumstances, the ruddy planet is at a distance from us which must be more than four thousand times as great as the earth's diameter. Here again we can apply the simple test of numerical calculation. Assuming, as we have already explained, that the intensity of the effect decreases like the law of gravitation, with the inverse square of the distance, we see that the effect of a wireless telegraphic signal transmitted across a distance equal to the diameter of the earth would be further reduced to a mere sixteen-millionth part if it had to travel over the distance to Mars. In other words, even if wireless telegraphy attained the utmost perfection that I suppose even its most sanguine advocates could possibly dream of, yet the efficiency of the apparatus would have to be increased a thousandfold, and then a thousandfold again, and finally multiplied by another sixteen, before an appreciable signal could be transmitted to Mars.

We have read much in the papers of the remarkable experiments of Tesla, which have deservedly obtained so much attention; but I think that, regarded as an agent for intercommunication with the planetary bodies, we must apply to Tesla's investigations the same tests as those we have already indicated for wireless telegraphy. Even though electrical phenomena produced in any one place were sufficiently intense to be appreciable by suitable instruments all over the earth, that intensity would have to be enhanced another sixteen millionfold before they would be appreciable on the planet Mars. To those who will consider what sixteen millions means, I think the probabilities of the case are fairly apparent. There are not sixteen million *inches* between London and Lancaster. A man sixteen million *minutes* old would be upward of *thirty years of age*. Sixteen million *grains* of wheat would weigh a *ton*.

I commenced this article with showing that no alleged phenomena on the surface of Mars are likely to receive much attention from those acquainted with astronomy unless the observations have been made in August or September. I end it by saying that no electric signaling to Mars appears to me to be possible, for the simple reason that the apparatus would have to be sixteen million times as efficient as that which would suffice to do far more than even the most ardent champions have yet, so far as I know, ventured to claim for it.

I do not, of course, say that electric waves may not traverse such a distance as that between the earth and Mars; the fact that sunlight reaches Mars, and that it is thence reflected back to us, shows, of course, that ethereal waves can, and do, traverse that distance. What we do assert is that the source of waves adequate to accomplish such a feat must be on such a scale as to be hopelessly beyond the power of man to initiate or control.

The subject of alleged communication with Mars therefore seems to me to be undeserving of serious attention.

TEA IN INDIA.

TEA is one of the staple products, and is becoming one of the principal articles of export of India to the United States. The plant in the wild state is a bushy shrub and sometimes a small tree, but in cultivation it is kept dwarfed by pruning. Like other plants long in cultivation, tea has produced several marked varieties which have been described as distinct species. The East has always been considered the home of the tea plant, China having grown it for centuries, although the original country of tea is not known; it has been found in a truly wild state in Assam. It may be cultivated in the East through a wide range from India to Japan. The industry, however, is not indigenous to India but rather a child by adoption. It is but little more than a century ago that an attempt was made to cultivate the tea plant in India; and it was not until as late as 1841 that the first public sale of tea occurred at Calcutta, which city seems to have ever since controlled the market of the Indian tea trade.

The area under tea culture in India at the end of 1899 was over 516,732 acres, 65 per cent of this acreage being in Assam in the valleys of the Brahmaputra and Surma rivers, 25 per cent being in Bengal; and the other 10 per cent being divided between the Northwest Provinces and the Punjab, in Northern India, and Nilgiris, Malabar and Travancore, in Southern India. The production of tea is, therefore, to the extent of nine-tenths of the whole area, limited to the two provinces of Assam and Bengal. There is a small area of 1,390 acres in Upper Burma; but in this province the leaf produced is not made into tea, but is picked to be eaten by the Burmans, and the area and the production may therefore be left out of the account. There are also a few other small areas devoted to the culture, such as the Jaintia and Chittagong Hill tracts, Simla and Cochin.

The cultivation in India has been mainly concentrated in tracts where a heavy rainfall and a humid and equable climate permit the repeated flushes and pickings of the leaf. In the valleys of the Brahmaputra and Surma, the yield averages about 448 pounds to the acre; in Bengal, about 406 pounds, and in Darjeeling, about 281 pounds. In Travancore, the average yield is stated at 644 pounds per acre. In the Northwestern Provinces, the yield per acre is 297 pounds. Elsewhere the yield is much lower. The area under tea has expanded from year to year without a pause during the last fifteen years. In 1885, the area was about 284,000 acres; in 1899, it had increased to 516,732 acres, the increase being in the ratio of 82 per cent. The average addition in the last five years (23,241 acres) was much larger than the average addition (13,365 acres) in the five preceding years.

The quantity of tea produced has increased in the past fifteen years in much larger ratio than the area under cultivation; for, while the area has increased 82 per cent, the increase in production has been 161 per cent. In 1899, the production in Assam, where the season was favorable in most of the districts, increased by more than 18,000,000 pounds, and in Bengal by more than 4,000,000 pounds.

The number of persons employed in the tea industry in 1899 is returned at 558,001 (permanently) and 96,615 (temporarily), or, altogether, about two-thirds of a million people (654,616 persons), which would work out to about 1.27 persons to the acre. The capital invested in tea plantations alone may safely be estimated to equal $100,000,000.

The exports, imports and consumption of tea are given in the subjoined figures. They represent the average for the last five years preceding 1899-1900, and may be taken as approximately the quantity of tea produced and consumed in India. These figures have been furnished me by J. E. O'Conor, C.I.E., director-general of statistics of the government of India.

	Pounds.
Indian tea:	
Produced	160,643,992
Exported	155,474,416
Left in India	5,169,576
Foreign tea:	
Imported	6,210,615
Re-exported	3,487,630
Left in India	2,722,985

Thus, approximately 8,000,000 pounds were left in

India, of which some 5,170,000 pounds were Indian and 2,720,000 pounds foreign; the bulk of the foreign tea being Chinese, though a substantial quantity consists of Ceylon tea. More than 1,000,000 pounds are purchased annually for the British army, and a larger quantity must be consumed by the European and Eurasian population and by natives, who, in some of the larger towns, are adopting the tea-drinking habit. For instance, in the city of Bombay the number of small shops, mainly owned by the Iranis, in which cups of tea are supplied at a small charge, are rapidly increasing.

The tea produced in India is exported mainly to the United Kingdom, to the extent of about 97 per cent of the average production. Some portion of the tea shipped to London is, of course, re-exported to other countries. A large increase in direct shipments from India to markets outside of the United Kingdom is noted, especially to Australia, Canada and the United States, where Indian tea seems to be growing in favor. Last year, India exported more than 154,000,000 pounds of tea to the United Kingdom alone. Australia is the next best customer, the United States ranking third. Last year, China herself took something like 1,250,000 pounds of Indian tea; but Russia, it may be mentioned, shows a steady decrease.

The prices of tea fluctuate greatly. Taking the price in March, 1873, to be represented by 100, it appears that until 1885 the level was well above that point, varying from 110 to 148. In that year, coincidently with the great fall in exchange and in general prices, the level fell to 90, and a low level was maintained in the following years until 1895, when there was a rise again to a high level. In 1897, prices again fell, and they have remained low since, as the consequence of the extremely rapid increase of production in India and Ceylon. In the statistical department of the government of India, the average prices of the various descriptions of tea sold at the public sales during the tea season have been computed for some years past.

It should be remembered that during this period the Indian rupee has greatly lessened in value, to-day being 1 rupee = 1s. 4d., or a little more than 32 cents in gold. Twelve pies make an anna, 16 annas a rupee, and 15 rupees £1 ($4.8665). As to the effect the depreciated silver currency has had on prices, I quote from India's able statistician, Mr. J. E. O'Conor, viz.:

"In the seven years since the closure of the mints, the exports of tea have increased by as much as 39 per cent; and, although prices have not been able to maintain all along what owners of tea estates would regard as a satisfactory level, in the face of the constantly increasing quantities shipped from India and Ceylon to what is after all a limited market, yet the industry has happily not been overtaken by the ruin and desolation which were so freely prophesied to be the consequence of placing the Indian currency system on a sound basis. Nor, happily, are there any indications that the industry is not likely to be even more solidly prosperous in the future than in the past. What a vicious currency system did in Brazil for coffee, the unsound currency system of India was doing for tea. The temporary stimulus given by depreciated paper or depreciated silver led to rapid extensions of cultivation; the increasing supply led to a fall in prices; the fall in prices led to a further demand for depreciation in the currency, in order that the speculative planter might find from the taxpayers the profit which he could no longer find from customers in an oversupplied market. In Brazil, this vicious circle is still being traveled, and the issue can only be either the ruin of the planters, who are aghast at any suggestion for currency reform, or a complete and hopeless insolvency of the country. In India, this road has been closed, and the capitalist will now place his money in tea with exclusive reference to the conditions of cultivation and consumption and without an eye to a depreciating currency. It is by no means improbable that the near future may see a gradual restoration of the price level, already initiated during the past year, to a level which will satisfy the producers and not restrict consumption."

It will be observed from the foregoing that during the past fifteen years, the acreage in tea in India has increased 82 per cent and the quantity of production about 161 per cent, while the prices have correspondingly been reduced. Whatever may be said about overproduction and the low level of prices, these conditions have nevertheless largely stimulated exportation, and India tea has captured new markets in the world's consumption and developed those already acquired as she could never otherwise have done; and, now that her tea has found favor, her problem of overproduction may be solved by the very causes that produced the conditions.

The quality of the tea depends largely upon the age of the leaves at time of picking; the younger the leaves the more delicate their flavor. There are as many as three, four, and sometimes more pickings during a season. While the many varieties of tea are no doubt produced by the same species, the quality of the product is largely determined by the preparation given to the leaves; it is also much influenced by the soils and situations in which the plants grow. The tea of the hills is different from that of the lowlands, and that which receives but little care is inferior to the highly cultivated. The slopes of the hills are preferred, at an elevation depending upon the climate, and free from stagnant moisture.

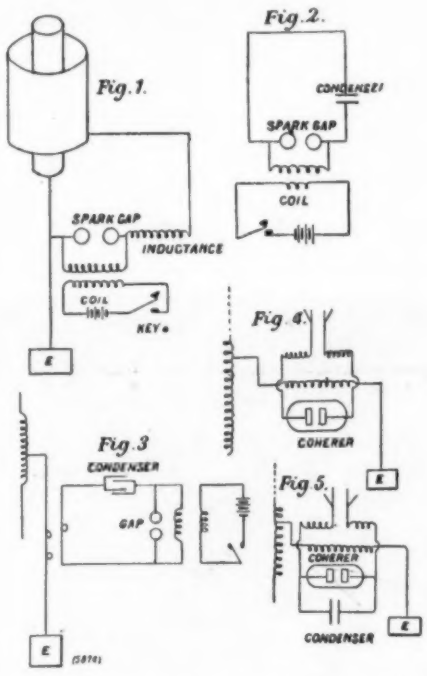
It requires about 4 pounds of fresh leaves to make 1 pound of dried tea. The teas of India and Ceylon are mainly dark, or "black" tea, though green teas are made from the same plant. If the process of drying is completed as rapidly as possible after picking, the tea remains green; but for black tea, the process is prolonged and repeated with intervals of exposure, sometimes for several hours, in order that a kind of fermentation may take place. The processes of curing vary greatly, and not always to the real improvement of the tea.

It has been only of late years that the finer qualities of Indian teas have found their way to America. The wealthy Chinese were early buyers, and a portion of the better quality was taken formerly by overland conveyance by Russian merchants.

The quality of the tea is greatly affected by the manner of making it, and I might say that it is impossible to make really good tea with hard water, though the excess of lime in the water may be corrected by the judicious use of carbonate of soda. In the proper making or infusing of tea, the object is to extract as much of the theine—the active principle and aromatic oil—which gives the aroma, and as little as possible of the tannin, which gives tea its astringency. This seems best accomplished by not boiling the tea, but by pouring boiling water on it and allowing it to infuse but a few moments. In some places in the East, tea is made in the cup. The proper quantity of leaves are placed in the cup, boiling water poured over them, and the cup covered for a short time with the saucer. To prevent the leaves from rising to the surface, a perforated bit of silver or silver filigree work is placed over them.—William T. Fee, Consul at Bombay.

SYNTONIC WIRELESS TELEGRAPHY.

On Wednesday, May 15, Mr. G. Marconi read a paper before the Society of Arts on "Syntonic Wireless Telegraphy." So popular was the subject that some time before the hour appointed the room was filled to overflowing, and many of the audience had to stand. Mr. Marconi commenced by explaining that his silence on the subject in the past was the result of commercial considerations, and not from any desire to withhold his scientific discoveries from those able to appreciate them. After a brief mention of his original apparatus, which is now well known, he turned to the development of the syntonic system, by which it is possible to send messages in such a way that they shall be taken up by one particular receiver, and no other. It is this power which gives to wireless telegraphy a commercial value, for as long as each receiver responded to every transmitter within its sphere of operations, there could be nothing but confusion. The original elevated straight wire, which was used as a transmitter, was a very good radiator of electrical waves, but its electrical oscillations died away with great rapidity, although they were very powerful while they lasted. The result was that it would affect receivers or resonators of considerably different pitch or period. The violence of its effect



set them in action by one or two impulses, although those impulses did not correspond with their natural periods. If a radiator be used giving off much less energy at each vibration, but emitting a series of waves over an extended period, then it will only affect a resonator tuned to that particular frequency. It will take some time (measured in thousandths of a second) for the radiator to set up a swinging electromotive force in the receiver sufficient to break down the insulation of the coherer, and to cause a signal to be recorded.

Early in 1900 the vertical wire was replaced by the arrangement shown in Fig. 1. In it the radiating and resonating conductors take the form of a cylinder, a cylindrical earthed conductor being placed inside. This form of radiating and receiving areas is very efficient, as compared with anything preceding it. One necessary condition of this system is that the inductance of the two conductors shall be unequal, it being preferable that a large inductance shall be joined to the non-earthed conductor. By using cylinders of zinc only 7 meters high and 1.5 meters in diameter, good signals could be sent over 50 kilometers, and these were distinctly received, although other signals were passing. The closely-adjacent plates and the large capacity of the receiver cause it to be a resonator possessing a very decided period of its own, and so no longer apt to respond to frequencies which differ from its own particular period. The receiver is not shown in Fig. 1, but consists of similar cylinders, the receiving induction coil, or oscillation transformer, being placed where the spark gap is in the old apparatus.

Another very successful syntonized transmitter and receiver were the outcome of a series of experiments carried out with the discharge of Leyden jar circuits. Since the chief difficulty with the old system was that the oscillations were so very dead beat, there was associated with the radiator wire a condenser circuit, which was known to be a persistent oscillator, to set up a series of persistent oscillations in the transmitting vertical wire. An arrangement is shown in Fig. 2, consisting of a circuit containing a condenser and spark gap, and this constitutes a very persistent oscillator. It is sufficient to place near one of its sides a straight metal rod or good electrical radiator; the only other condition necessary for long distance transmission is that the period of oscillation of the wire or rod shall be equal to that of the nearly closed circuit. Stronger effects of radiation are obtained if the radiating conductor is partly bent round the circuit, including the condenser, so as to resemble the circuit of a transformer.

An arrangement was first constructed consisting of a Leyden jar or condenser circuit, in which was included the primary of what may be called a Tesla coil, the secondary of which was connected to the earth or aerial conductor. The idea was to associate with the compound radiator a receiver tuned to the frequence of the oscillations set up in the vertical wire by the condenser circuit. The first trials were not successful, because the necessity was not recognized of attempting to tune to the same period of oscillation (of octaves) the two electrical circuits of the transmitting arrangement (these circuits being the circuit consisting of the condenser and primary of the Tesla coil or transformer), and the aerial conductor and secondary of the transformer.

Unless this condition is fulfilled, the different periods of the two conductors create oscillations of a different frequency and phase in each circuit, with the result that the effects obtained are feeble and unsatisfactory on a tuned receiver. The syntonized transmitter is shown in Fig. 3. The period of oscillation of the vertical conductor can be increased by introducing turns, or decreased by diminishing their number, or by introducing a condenser in the series with it. The condenser in the primary circuit is constructed in such a manner as to render it possible to vary its electrical capacity.

The receiving station arrangements are shown in Figs. 4 and 5. Here we have a vertical conductor connected to earth through the primary of a transformer, the secondary circuit of which is joined to the coherer or detector. In order to make the tuning more marked, an adjustable condenser is placed across the coherer in Fig. 5. Now, in order to obtain the best results, it is necessary that the free period of electrical oscillations of the vertical wire primary of transformer and earth connection should be in electrical resonance with the second circuit of the transformer, which includes the condenser.

In order that the two systems, transmitter and receiver, shall be in tune, it is necessary (if we assume the resistance to be very small or negligible) that the product of the capacity and inductance in all four circuits should be equal. Experiments have confirmed the fact that the receiving induction coils, having the secondary wound in one layer and at a certain distance, say, 2 millimeters (to cause the capacity to be so small as to be negligible), have a time-period approximately equal to that of a vertical conductor of equal length. If, therefore, we are using an induction coil having a secondary 40 meters long on the receiver, we should use a vertical wire 40 meters long at both transmitting and receiving stations. By so doing we have the two circuits at the receiving station in tune with each other, and only have to adjust the capacity of the condenser at the transmitter, which can easily be done, either by means of a condenser having movable plates that can be slid, more or less, over each other, or by adding or removing Leyden jars.

If we start with a very small capacity which we gradually increase, a value of the capacity will be reached which will cause signals to be recorded on the receiver. Supposing the receiving system to be within the sphere of action of the transmitter, then the signals will be strongest when the capacity of the condenser is of a certain value. If we still increase the capacity, the signals will gradually die away; while if we go on increasing the capacity, and, at the same time, add inductance to the aerial, to keep it in tune with the condenser jar circuit, we are still radiating waves; but these do not affect the receiver. If, however, we add inductance or capacity to the wire (Fig. 5), and also to the ends of the secondary, we find ourselves able to receive messages from the transmitter, although we are utilizing waves of a different frequency. If two apparatus, such as shown respectively in Figs. 4 and 5, be connected to one vertical wire, evidently one will respond to vibrations of one frequency and the other to vibrations of another frequency.

By the improvements in his apparatus, and particularly by the use of the cylinders in place of the vertical wire, Mr. Marconi has been able to render his apparatus far more portable. He has constructed a steam motor-signaling car for use with an army. On the roof of this car, which is of the omnibus type, there is placed a cylinder, which can be lowered when traveling, its height being only 6 or 7 meters, and by this means communication has been easily carried out with a syntonized station over a distance of 50 kilometers (31 miles). A 25-centimeter spark induction coil, worked by accumulators and taking 100 watts, is used for transmitting. A strip of wire netting laid on the ground is sufficient for earth connection, even when traveling, or in place of this the electrical capacity of the boiler of the car can be used as "earth."

The greatest distance yet covered by wireless telegraphy has been from the Lizard to St. Catherine's Point, or 200 miles. The amount of energy required was not more than 150 watts. The aerial conductors consisted of four parallel vertical wires 1.50 meters (60 inches) apart, and 48 meters long, or a strip of wire netting of the same length. Evidently very considerable progress has been made in wireless telegraphy during the past few months, and the efforts of Mr. Marconi have now gone far to convert it from a random phenomenon, the action of which was only imperfectly guessed at, into a scientific process which can be controlled and utilized. Already the navy is equipped with many sets of apparatus, and it is to be expected that the army will soon be following its example.

Port Charges in Colombia.—Minister Hart cables from Bogotá, April 30, 1901, that from the 15th of May, port charges will be payable in gold.

[Continued from SUPPLEMENT, No. 1326, page 21260.]

THE DISTRIBUTION AND CONVERSION OF RECEIVED CURRENTS.*

By HENRY GORDON STOTT.

CONVERSION.

THE 11,000-volt 25 cycle three-phase current distributed to the seven sub-stations in Buffalo is manifestly unfit for use in the supply of power or light without transformation in the former and conversion in the latter case, as 25-cycle is much too low a frequency for arc lighting, which promises to displace incandescent lamps to a great extent in the near future.

In discussing the various means employed to make this power available to the customer, we will begin with the simplest and then proceed to the more complex. The simplest and most efficient method is evidently to reduce the pressure by means of static transformers of large capacity and high efficiency and deliver three-phase 2,200-volt current to the various customers by means of a secondary network of cables. This is done in sub-stations Nos. 1, 2 and 3, where 2,200-volt three-phase current is delivered by underground and overhead cables to customers for use in malt houses, grain elevators, machine shops, drydocks, bakeries, tanneries and all sorts of manufacturing establishments to the extent of about 4,000 horse power. This power is utilized in the above places chiefly by means of induction motors, some of which receive the current directly at 2,200 volts, but in the majority of cases at a reduced pressure of 440 or 220, the reducing transformers being supplied by the customer. For grain elevators, in which a large amount of fine dust of an explosive nature is present, the induction motor presents an ideal solution of the power problem as the safety and controlling devices can be located in a separate building, so that no spark can cause an explosion or fire. The efficiency of transformation with this system is evidently that of the transformers only, which in sizes of 250 kilowatts and upward is from 97.5 to 98.3 per cent at full speed.

The largest user of power in Buffalo is the International Traction Company, which receives a total of 7,000 horse power in five sub-stations, No. 1, Cold Springs, Walden Avenue, Eagle and Jefferson Streets, and Elk and Seneca Streets, where the power is distributed to their 550-volt direct current feeders after being transformed from 11,000 volts to 375 volts and converted in rotary converters to 600-volt direct current.

An interesting comparison is the relative efficiencies and cost of static transformers and rotary converters as against motor generators receiving the 11,000-volt current direct into the motor and converting it into 600-volt direct current by means of a generator coupled to the same shaft, and is given in the following table.

From the table it will be seen that the transformer and rotary converter give 3.27 per cent at full load, 4.27 per cent at three quarter load and 4.98 per cent at one-half load better efficiency than the motor generator set.

The investment shows a saving in favor of transformers and rotary converters of about 19 per cent, so that for purposes such as railroad work, where no great refinement of regulation is required, the rotary is beyond doubt the best and most economical.

A view of a sub-station is given in Fig. 6, which is typical of all; the incoming current enters a three-pole oil switch, which is known as an emergency switch, and from there branches to several oil switches, each of which controls the primaries of three 150 kilowatt static air-blast transformers connected in delta; the secondaries, also delta-connected, go direct to the collector-rings of a 400 kilowatt rotary converter, so that the three static transformers and rotary converter form one unit, being in fact started from the direct-current end and synchronized by means of small potential transformers on the 11,000-volt primaries.

To provide for the emergency of a total shut-down of the power circuits, those sub-stations which have no storage battery auxiliary from which direct current may be got for starting the rotaries, a small motor generator set is installed, consisting of a 30 horse power induction motor direct-connected to a 20 kilowatt 600-volt direct-current generator. This set is supplied with alternating current by means of a three-phase oil-cooled transformer, reducing the pressure from 11,000 to 375 volts; as soon as the power is on the cables the induction motor is started, the small direct-current generator is connected to the bus-bars and one of the rotaries started and synchronized in the usual way, after which the motor generator set is shut down and the remaining rotaries started from the first. From the five sub-stations distributing power to the direct-current feeders great economy of distribution is obtained and an equality of pressure at practically every point of the system, which would be practically impossible with a single plant with 550-volt feeders covering the same distance. Storage batteries are installed at Sub-stations No. 1, Cold Springs and Eagle and Jefferson, having a total capacity for 1½ hours of 2,400 horse power at 575 volts. They are used principally to help carry the peak load between 5 P. M. and 6:30 P. M. and to take up part of the extreme fluctuations of load through differentially wound boosters.

We now come to the last and most interesting plant connected to the transmission system in Buffalo, viz., that of the Buffalo General Electric Company, the transformer-house of which is marked "Sub-station No. 3" on the sketch showing cable system, in which 4,000 horse power is received from the power company, and after being transformed to 360 volts is converted, by means of motor generator sets, rotaries, etc., into four different kinds of service—constant continuous current for street arc lighting, 60-cycle quarter-phase current for incandescent and arc lighting in the more remote districts, three-wire 220-volt continuous current for the down-town district, and 550-volt continuous current for power to motors, elevators, etc.

The transformer-house, built as an annex to the main station, has twelve 250 kilowatt transformers, reducing the three-phase 11,000-volt current to three-phase 360 volts. The transformers (see Fig. 7) are arranged in two rows instead of three as usually in order to facilitate the rapid exchange of one in case of trouble. By arranging them in this way the transformer has only to be raised half an inch by the hand-crane and then run out of the way to make room for the spare one, an operation requiring only an extremely short period compared to that necessary to lift the transformer over the others. The transformers stand over a brick air-chamber 30 feet by 9 feet by 7 feet high, into which three 2 horse power induction motors direct-connected to air-blowers force cool air,

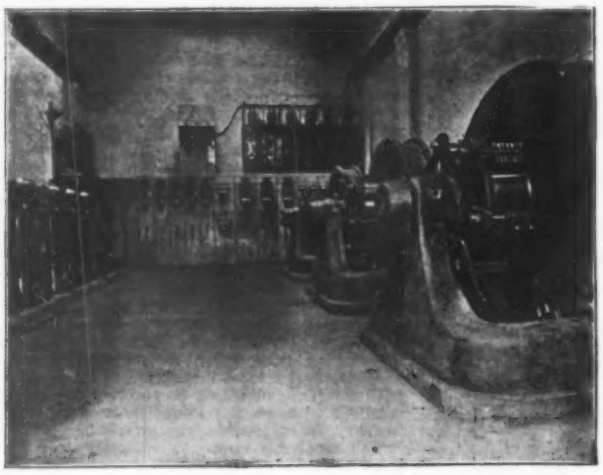


FIG. 6.

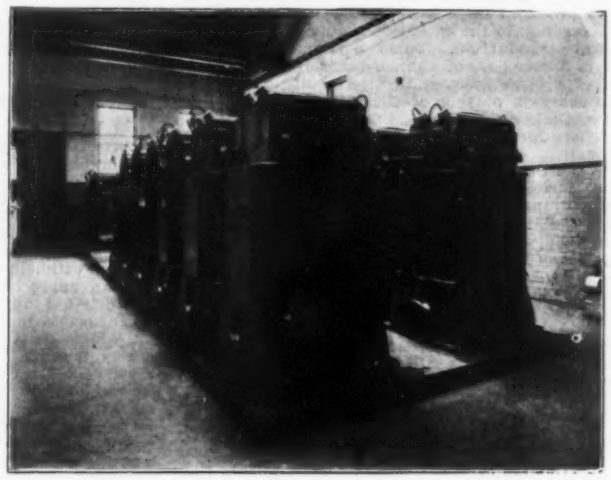


FIG. 7.

EFFICIENCIES: 200 K.W. UNITS.

	Transformer.	Rotary.	Combined.	Motor.	Generator.	Combined.
Full load.....	97.5	93.0	90.67	93	92	87.4
¾ load.....	97.1	92.5	89.81	94	91	85.54
½ load.....	96.0	90.0	86.40	92	88.5	81.42

FIG. 8.

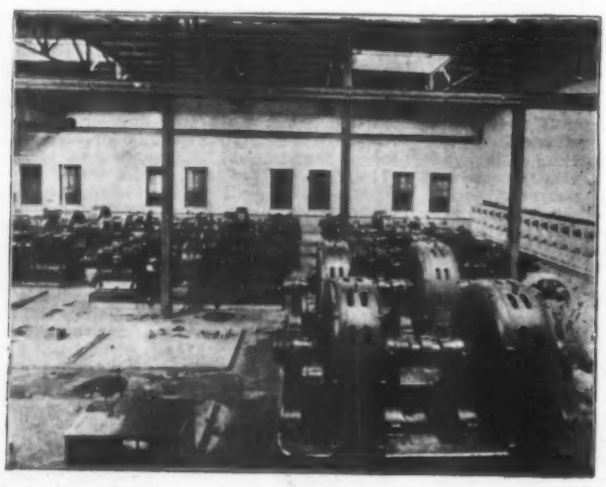


FIG. 9.

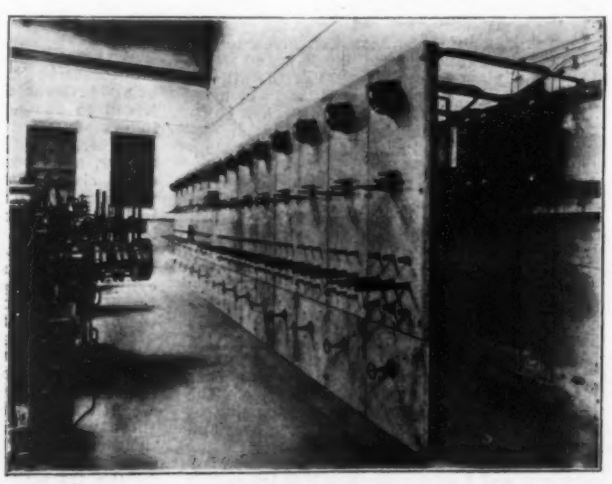


FIG. 10.

* A paper read at the 153d Meeting of the American Institute of Electrical Engineers, New York, March 22, 1901.—From the Transactions of the Institute.

giving an even pressure of about half an ounce in all parts of the chamber. Access is had to the air-chamber through double air-tight doors, so that a man can work on the terminals or connect up a new group without interfering in any way with the air supply. Iron shelves on the outside of the brick walls of the air-chamber form supports for the primary

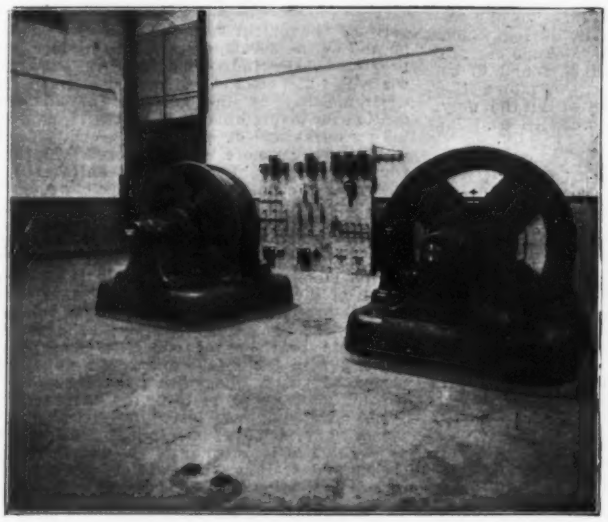


FIG. 12.

cables leading to the switchboards on the one side and for the secondaries on the other, giving wide separation for safety, similar to those in Fig. 8.

The transformers are connected to the primary and secondary switchboard panels by rubber-insulated and lead-covered cables; each transformer is wired single-phase to the panels, the delta connection being made after passing through spring expulsion type aluminium fuses on the primary side, and ordinary long break aluminium fuses with barriers on the secondary side, so that in the event of a transformer burning out it will cut itself out of circuit without affecting the other two of the same group.

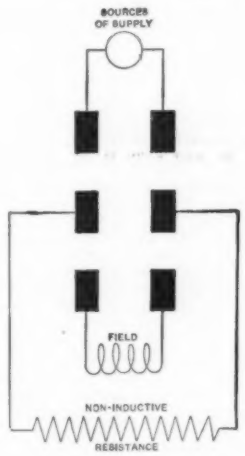


FIG. 11.—CIRCUITS OF SWITCH SHOWN IN FIG. 10.

The secondary current after going through the usual recording and indicating instruments, terminates in three heavy copper bus-bars, extending the full length of the secondary board, to which are attached the cables bringing the current into the main building of the Buffalo General Electric Company.

In adopting the secondary voltage of 360, a number of points were taken into consideration, the principal one being that a large and healthy day load in 550-volt direct-current motors was being supplied at the time steam was used for motive power, and could not well be discontinued, so that voltage was adopted which would permit of rotaries being run without any further transformation. This pressure besides being very safe for cables and motors, is a very economical one to build for, as it permits of the use of bar winding on all sizes, and as all motors are of the revolving field type, the question of carrying heavy current in the collector rings was left out. The only additional cost due to the low pressure was in the cables within the plant, and this was more than balanced by the saving in a further transformation for the 550-volt rotaries and in the additional safety of bar winding versus wire.

The power house, Fig. 9, is a building 91 feet by 91 feet, having a row of columns down the center, each half of the building being spanned by a crane traveling the full length, with transfer points from one crane to the other.

In this building having 8,281 square feet of floor surface are installed 6,460 horse power in motors, 6,073 in generators, and 600 horse power in rotaries, a total of 13,133 horse power in electrical machinery, giving a floor space of 0.63 square foot per horse power or 1.24 square feet per horse power of generating capacity, including all regulating apparatus, switchboards, etc.

APPARATUS FOR STREET ARC LIGHTING.

At the present day if the problem of arc lighting for street purposes with 25-cycle three-phase current supplied, were to be placed before an engineer, several methods of solution would suggest themselves in the following order: First, rectifiers; second, motor generator sets, converting to 60 cycles constant potential with some form of transformer or reactive coil to regulate for constant current; third, motor generator set converting to constant continuous current; fourth, motor generator set converting to constant alternating current with series transformers and condensers.

The full load efficiencies of the four systems with comparative investments and full power factors are approximately as follows:

1	2	3	4
Rectifiers	Motor Generators 60-Cycle.	Motor Generators Constant D. C.	Motor Generators Constant A. C.
88	83.94	78.9	86.6% Efficiency.
53	100	94	54 % Investment.
70	100	100	100 % Power Factor.

From the above table it will be seen that the rectifier

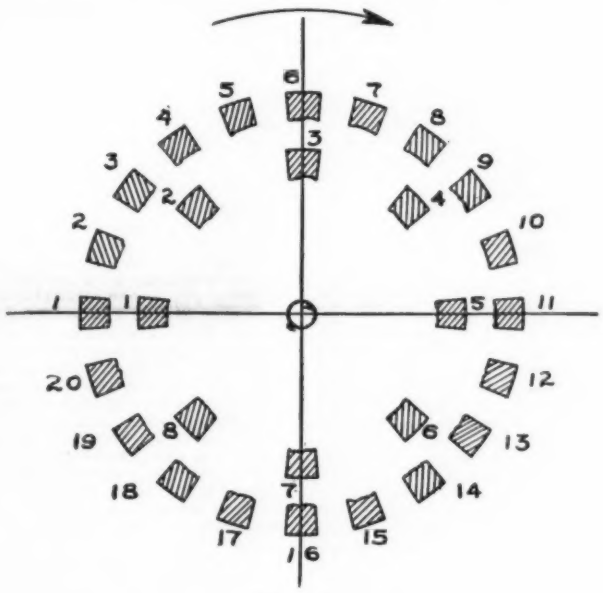


FIG. 13.

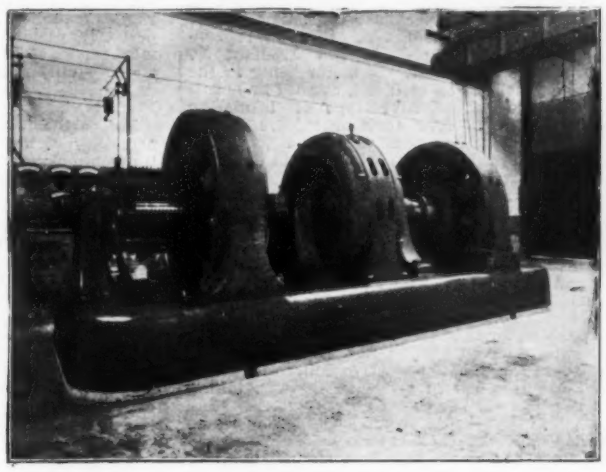


FIG. 14.

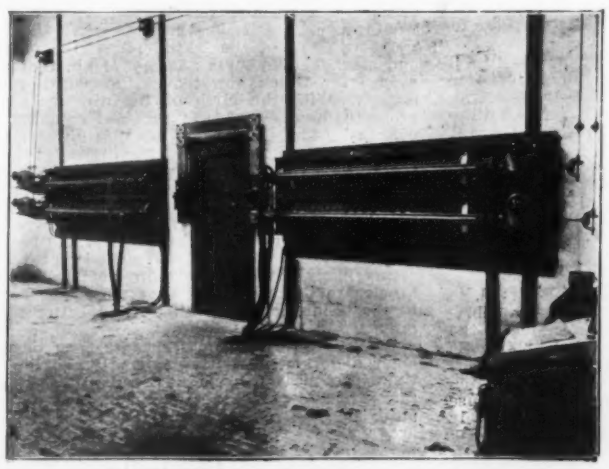


FIG. 15.

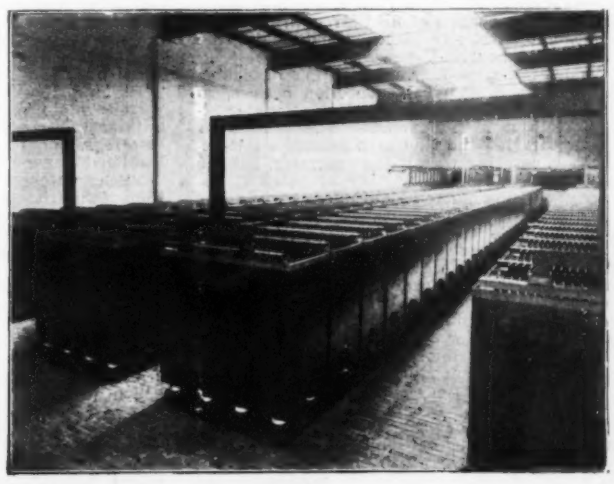


FIG. 16.

leads in all respects save one, viz., power factor (the power factors given are those of the 25-cycle end, the receiver power factor being of small importance), but in a system where the arc lighting forms a considerable portion of the system this is a serious feature, especially with generators not having good inherent regulation.

Owing to existing contracts with the city, the company was forced to adopt the third plan, but after the expiration of the present contract it will probably adopt the fourth plan, installing inclosed A. C. lamps.

The arc lighting equipment at present consists of 14 motor generator sets, each set consisting of one 150 kilowatt revolving field type three-phase synchronous motor direct-coupled to two 125-light 9.6 ampere Brush arc generators, the motor being in the center, with a generator on each end, coupled by means of a very simple but effective type of insulating coupling, consisting of four arms or spiders on the motor-shaft and a similar number on the generator, compressing spring rubber rolls 3½ inches in diameter by 4¾ inches long between them.

These motors are started in a very simple manner. The switchboard panel, shown in Fig. 10, controlling each motor has mounted on it one ammeter, one double pole field switch with discharge resistance, as shown in sketch, Fig. 11, three single pole double throw knife switches and a rheostat. The fuse base is mounted on the back. Fastened to the wall behind each panel are the reactive coils for starting the motor.

To start the motor the three single pole switches are thrown down, thus connecting the motor armature to the bus-bars through the reactive coils; the motor comes up to full speed in about 50 seconds, taking at the start about 150 per cent full-load current. The time of attaining synchronism is determined by touching the blades of the field switch connected to the revolving fields on the discharge resistance clips and noting if any spark occurs. In the absence of any, the field switch is closed, exciting the fields and the single pole double throw switches turned up one at a time (the motor running single-phase meanwhile).

The spark at the discharge resistance terminals is, of course, due to the difference in frequency or slip between the impressed frequency and that due to the speed of the motor. At the start this gives about 2,200 volts, dying down in inverse ratio to the speed attained, to zero, at synchronism.

550-VOLT POWER SERVICE.

The 550-volt power service is supplied from rotary converters (Fig. 12), in the usual way, calling for no comment beyond the method of starting from the A. C. end which is done in exactly the same way as in the synchronous motors; the fields being stationary, a multiple blade switch is mounted on the frame of the machine to isolate each field winding, and thus break up the induced E. M. F. at starting.

60-CYCLE SYSTEM.

Three 500-kilowatt three-phase synchronous revolving field type motors direct connected to 500-kilowatt revolving field 2,200-volt quarter-phase generators, furnish the current for this system. The feeders are connected to double throw oil switches, so that they can be thrown from one phase to the other to balance up the load, a further control of the voltage being obtained by means of regulators on each phase. Some rather unusual problems presented themselves in synchronizing these 60-cycle generators. The motors having eight poles and the generators 20, it is evident from the sketch, Fig. 13, that only every fifth pole of the motor will be the proper point to lock at. At first it was supposed that by opening the field switch on the motor it would slip a pole when the generator field was excited, and the whole iron losses acting as load, but the voltmeter showing the resultant voltage between the bus bars and the ingoing generator refused to move. The synchronous motor was too good a hysteresis and reaction motor, but the solution was found in putting in a reversing field switch on the motor, thus causing it to slip a pole on each reversal. The inner circle, shown in Fig. 13, represents the motor poles, and the outer the generator. If the generator carrying load has its poles in the position 1, 1, at the moment the field switch on the motor about to go into service is closed, and the latter locks with 1, 1, in the position of 4, it is evident that we must reverse the motor fields several times in order to make it slip back to position 3, then 2, and finally 1. While the position 3, 6, has a similar relation to the generator pole to that of 1, 1, yet the polarity is reversed on the generator so that unless we reverse the generator field also, the motor must be made to slip to position 1, 1. Another peculiar feature was that supposing the bus bar voltage and that of the ingoing machine to be the same, and the machines apparently in phase, if thrown together the ingoing machine would not take more than a small fraction of the load, and no change of field strength of either motor or generator had any effect, beyond making the generator carry idle current.

We have here the peculiar combination of double synchronism, with mechanical connection besides, so that either machine may act as motor or generator according to conditions. The explanation is as follows:

The motor carrying the load sags behind a few degrees of phase, carrying with it the generator, but the latter having 2.5 times the number of poles of the motor, any sag of the motor is multiplied by 2.5, thus causing a difference of phase between the loaded generator and the unloaded one great enough to render division of load impossible. Increasing the field strength of the light generator merely results, under these conditions, in the unloaded generator supplying idle cross current out of phase with the bus bar current, and therefore not putting load on its own motor. Manipulation of the motor field rheostats can evidently accomplish nothing to bring the generators into phase.

The solution is a rather startling one, and is found in the use of oscillating currents. The ingoing generator is excited to such a degree that the resultant voltage from it and the bus bars is equal to the latter; this means at half load on one, and the other light, an increase of 4 per cent in voltage, indicating a phase angle difference of about 22.5 in the generators and 9 degrees sag in the motor. The motor fields are weakened and the unloaded generator thrown on the bus bars. Owing to the difference of voltage and phase the sudden closing of the circuit establishes strong oscillatory currents between the generators; these are transmitted mechanically to the motors and repeated, the amplitude gradually decreasing from a maximum value of 100 per cent full load current to zero as the equilibrium of the circuit is established. The whole time, from the moment of putting the unloaded generator into multiple to the disappearance of the oscillations, is usually about 45 seconds, during which the field strengths of the generators and motors are rapidly equalized, and the load will be found to be perfectly divided between the two generators, the mechanical oscillations having resulted in the only stable equilibrium possible under the conditions.

EXCITERS.

Before the installing of the storage battery it was necessary to have some quick means of getting continuous current, to determine the polarity of the rotary converters and energize the fields of the synchronous motors in case of a shut-down on the power circuits, and for this purpose two exciter sets consisting of 30 horse power induction motors direct connected to 20-kilowatt 125-volt continuous-current generators were installed. Since the installation of the battery, all the exciting current is taken from it during the period of heavy load, for two reasons; first, to reduce the peak load; second, to automatically maintain an almost constant power factor of 98 per cent leading, on the total load of the plant, due to the Edison load increasing (and bus bar pressure increasing correspondingly) simultaneously with the other station load and thus giving increased C. E. M. F. in the motors.

EDISON SYSTEM.

There are evidently two ways of converting three-phase 25-cycle current into 120 to 150-volt continuous current, one being by means of transformers with rotary converters and the other with motor generator sets.

A comparison of the net efficiency of both systems for 200-kilowatt units is given in the following table, the rotary including in its circuit some form of regulators capable of varying the voltage 25 per cent:

	Motor Generator.	Transformers and Rotaries.	Difference.
Full load	87.40	89.87	2.47
Three-quarter load	85.54	88.70	3.16
Half load	81.42	84.90	3.48

Owing to the additional regulating apparatus necessary with the rotaries, the first cost in either case is practically the same.

From the above efficiencies, rotaries would seem to be indicated as the best chroice, but in an extensive power transmission scheme where nearly 50 per cent of the load is used for railroad purposes, and the generators have a comparatively poor inherent regulation to enable them to withstand safely severe short-circuits on the lines, rotaries have had to be abandoned for this service, every fluctuation of the line potential being reproduced on the direct current side. Two 100-kilowatt rotaries were installed, but additions have been made to the system only in motor generator sets, two of which are installed, the first of which is a direct connected set consisting of a 425-kilowatt motor coupled to two 200-kilowatt generators (Fig. 14), having a very wide range of voltage to permit of charging the battery direct without the intermediary of a booster; the second, now being installed, is an 850-kilowatt motor direct coupled to two 400-kilowatt generators.

A 150-kilowatt booster set consisting of a synchronous motor coupled to two direct current boosters is used for charging purposes, and for carrying long feeders. The storage battery has a capacity for one and a half hours of 6,000 amperes at 150 volts (Fig. 16), there being 75 cells on each side of the system with two 20-point end all switches (Fig. 15), on each side to give control of the pressure under varying load.

A peculiar point observed is that a motor generator set and rotaries operating in multiple on the direct current side, tend to regulate one another, with varying speed, for constant potential. The rotary being practically independent of speed, a fall of speed or frequency on a transmission system having a large amount of inductance reduces the reactance, and a rise in speed increases the latter so that but for changes in the impressed voltage the rotary should give the best results on a system driven from water power in which the governors must of necessity be sluggish. The motor generator, on the other hand, is independent of changes in impressed voltage, but sensitive, especially with undersaturated fields, to change of speed.

In concluding this paper the author wishes to express his obligations to The American Electrician for permission to use cuts; to Mr. P. F. Sellers, of the Cataract Power and Conduit Company, for outline drawings, and to Mr. G. A. Harvey, of the General Electric Company, for photographs.

Much matter, which could, under a strict construction of the title, have been put in has been left out, and matter which in the author's opinion is more interesting and practical substituted.

A CASTLE IN ARIZONA.

NEAR Phœnix, on the Southern Pacific Railroad, is a high mound within which is the crumbled débris of a once lofty structure which is still standing to the height of three or more stories. Around the old castle are the lines of a moat. High walls guarded the castle, and in the southwestern corner was once a tall watch tower or citadel. To the south is a smooth expense of several acres, which may have been an assembly place for the people, and within a hundred yards north are the outlines of a circular reservoir. The castle to-day measures 380 feet in length by 180 feet in width, and is much larger than the far-famed Casa Grande, which measures only 50 by 60 feet. Dr. J. Miller, president of the American Antiquarian Society of Arizona, is engaged in exploring it.—The American Antiquarian.

THE CITIZEN: HIS SCHOOLS, HIS INDUSTRIES, HIS LIFE.*

By R. H. THURSTON.

EVERY thoughtful man perceives that, as time rolls on and as the development of this modern civilization progresses, the individual becomes more and more controlled and confined, hampered and directed by his environment, and the necessity of an early preparation for fitting himself to that environment and for taking advantage of every change marking that evolution becomes more serious, more vitally imperative. Our parents might roam the continent and somewhere find, each, that environment within which it was possible to make one's self safe without being compelled to fit the individual to the crowd, to all the complexities of a life which is always growing more complex and intimidating.

This adaptation cannot, at this stage of our evolution of the industrial system and of a working life such as practically all men and many women have to take up, be secured by instinct; it must come of a deliberate provision of education and training, beginning with the infant and continuing through the period of youth, and, with certain classes, on even beyond adolescence and to the stage of maturity. With advancing complexity of civilization, instinct (hereditary memory) continually loses its efficiency as a guide and protector of the individual life; education and training, the wisdom of age reduced to formal expression and of experience stored in available form, become more and more vitally essential. This means that the ability of the parent and of the State to provide such knowledge, in schools and colleges and professional seminaries of learning, is constantly becoming more important in the struggle of the individual for life and for the good things of the world; that the position of the individual in the social scale and among his fellows is steadily exerting a more important and more controlling influence and that heredity must more and more tell through purely material success and by accumulation of material potent powers. Where, once, a man could make a success in a generation, even starting from the lowest level, and where, of late, two or three generations are oftener needed, highest success in all great achievements can soon only be expected to follow upon foundation building which has occupied ancestors of several generations, steadily and with persistent adherence to the fundamental elements of progress. This, again, means the gradual progression of social stratification in a more and more distinct manner—a result which, however unsatisfying to our democratic inclinations, must probably be accepted as inevitable. We shall probably enjoy, however, the compensating fact that the lowest strata will continually find higher levels assigned them, so far as their position is determined by ability or good fortune. All honest endeavor will be better rewarded and the extent of reward will include a wider range—and with extension of that range mainly in the upward direction.

Such conclusions can hardly fail to follow any serious study of the progress of modern life, and especially of the modern industries and their resultant developments, in any civilized country. The correctness of this conclusion is shown clearly by the statistical, as well as the more general method of historical investigation. It is this which has brought about the discovery that, on the whole, such progress tends to reduce, relatively, the numbers of the very rich and of the very poor, increasing by similar proportion the relative number of the intermediate, well-to-do class while all the time raising the standard of living of the latter. It is only necessary for a person of middle age to look back to the days of his childhood to perceive the last fact distinctly, and a perusal of the pages of Buckle or Lecky, or the reading of the general literature of the last century will show how rapid this change, moral and intellectual as well as material, has been since the crystallization into form of the contemporary industrial method and since the entrance of any people into the characteristic form of modern life. Read, for example, if more detail is desired, Wells' Recent Economic Changes as a supplement to portions of Draper's Intellectual Development of Europe.

The indications of a coming change may be seen as far back as the beginning of the seventeenth century, when that wonderful renaissance of scientific research began, which has continued uninterruptedly to our time; but the progress then initiated only became sensible, and its movement became a distinct acceleration, of rapidly increasing rate, in the eighteenth century, after the inventors who in ancient times would have been made demi-gods, gave their fellows the machinery of the textile industries, of the iron and steel manufactures and, above all, that archimedean lever which now moves the world—the steam engine. With the birth of the nineteenth century, progress assumed aspects previously unknown and change became so rapid as to cause disaster to many while promoting the best and highest interests of the world as a whole. The "trend of progress" not only became marked, but its curve took on increments of gain which were themselves subject to acceleration. The "curves of progress" rapidly, and more sharply, rise with the growth of the century, and as yet with no indication of change of law. The twentieth century seems likely to illustrate quite as markedly as the nineteenth this wonderful progress of the great body of the people toward a higher and better life in all its phases.

But there are many other gages than those of the older historian, measuring this progress, and, in our time, the measure generally regarded as the most satisfactory is that of the consumption of iron and steel, since these forms of the most precious metals are employed, directly and indirectly, in every department of modern life. Its most important indus-

* An Address delivered before the Science Teachers' Association, Rochester, N. Y., Dec. 29, 1900.—From the Sibley Journal of Engineering.

tries and most widely spread blessings are absolutely dependent upon the use of these metals for their value and fruitfulness. All great industrial operations, whether in textile manufactures, in food-production, or in transportation, are dependent upon the supply of iron and steel, and the amount produced *per capita* thus measures the wealth, the comfort and the general prosperity of the country. During the century, for example, our own country has increased its annual production from an insignificant amount to nearly fifteen millions of tons, and from a correspondingly insignificant weight, *per capita*, to nearly four hundred pounds for every man, woman and child in the nation, to one ton per family. The rate of consumption is still growing, that of production is still increasing in still higher ratio and we are beginning to supply the markets of the world with our manufactured iron and steel.

But there is still another measure of progress which is, in a sense, better than even iron and steel production and consumption. Although not more accurate, probably—I doubt if anything could be more accurate—it is more satisfactory in that it shows us a more interesting aspect of progress, a more important phase of evolution, than the material gage. This is the progress of higher education, as supplementary of that common-school education of earlier decades, which latter lies, in fact, at the bottom of all intellectual advance in our country. The common-school system and the political and individual freedom of the American citizen, together, have promoted most effectively the march of invention and the perfection of the industrial systems, as well as all other good works in every department of human life. The particularly impressive phase of educational advancement in our own time has been the extraordinary stimulus given higher education, especially in those departments of applied science which have furnished the scientific basis of modern industrial life.

Studying the "Trend of National Progress," * as I have called it, we find that the iron and steel production may be shown by a set of curves of progress which have their very exact counterparts in the curves which relate the growth of the working power of the world since Watt, to the flow of time during the century, and these in turn will be found to have a very close relationship to those which exhibit the development of modern forms of technical school and the scientific departments of our academies, colleges and universities. All show a low figure for output in the early part of the century; a hardly perceptible growth in the earlier decades; a sensible acceleration toward the middle of the century; rapidly increasing advance, with an increasing *rate* of acceleration, as we enter upon the last quarter-century, and all exhibit wonderful progress in these later years.† Laying down these three curves upon "squared paper," a singular correspondence will appear and there becomes obvious the fact of some common cause. Comparing the series with another graphical presentation, that of the growth of that product of industrial activity which represents permanent wealth, that class of products of manufactures and industry which Mr. Mulhall calls "sundries," we find an almost exactly similar trend of the curve of progress as indicated by either line; and, if we further investigate the subject, we find still another set of similar curves representing the gain of the nation in wealth, both aggregate and *per capita*, and especially in that portion of accumulating wealth which is secured by the people as wages, both aggregate and *per capita*.‡ All these simple, yet most expressive and instructive pictures of the progress of the nation are, each in its way, expressions of the progress of the civilized world; for all civilized nations furnish us just such illustrations.

During the nineteenth century, the inventor has increased the power utilized from the forces of nature from, perhaps, five millions of horse power at the time of Watt, to in this country alone twenty-five millions at the middle of the century, to seventy millions in 1875, and to about one hundred and fifty millions at the end of the century. Wealth increased slowly in the early half of the century, doubled several times between 1850 and 1875, and then commenced, with the latter date, that wonderful progress which we have all observed, amounting now, with the close of the century, to about twenty-five thousand millions of dollars in houses, fifteen thousand millions in lands, an equal amount in railroads, some five thousand millions in factories, and an equal sum in cattle; while the "sundries" account, measuring all the characteristic comforts of civilization, has risen from two or three thousand millions in 1850, to twice that sum in 1875, and to thirty thousand millions in 1900; wages have risen from about three hundred millions aggregate, in 1850, to seven hundred and fifty millions in 1875, to about five thousand millions in 1900; the operatives receiving, each, on the average, not above $250 in 1850, and $350 in 1875, reaching $500 in 1890, and nearly $700 to-day—the highest compensation in any country in the world and in all history. Of this, also, every dollar and every day's labor buys more to-day than ever before in the history of civilization. The twentieth century opens with this marvelous and optimistic outlook, and, if no wars or pestilences or other social catastrophes break the curve, its history is likely to be as marvelous from the point of view of the generation living at the dawn of the next century—indeed, vastly more marvelous than the retrospect which we enjoy at the close of the nineteenth century.

Could similar statistics be secured, and pictures in curves of progress illustrating the advance effected in educating the people, very similar and no less surprising and encouraging conclusions would be reached, both regarding the past and respecting the future. To-day sixteen of the leading colleges of the United States report about forty thousand students registered, and their annual output is about eight thousand men, of whom, probably, one thousand are in the departments of engineering alone, and a still larger proportion in the more ancient departments of the so-called learned professions; to which latter, however, the former are to be added, since their requirements for admission are more exacting and their courses of instruction are more crowded, are generally more mathematical, and are fuller of branches demanding brain and work. The century has seen an enormous growth of collegiate work, and especially in the departments of applied science.

The compulsion which has brought about this immense development of higher education has consisted, we must conclude, of three main elements: (1) that ability attained, through increased and more widely and uniformly distributed wealth on the part of the people, to secure higher education, which always marks such progress as we have traced in our material evolution; (2) that constantly growing demand for more generally learned men in the professions, including now the constructive professions; (3) that constantly growing and increasingly intense demand, in all industrial vocations, for a scientific basis for all industries and for highly trained, for learned men in all great enterprises and in every system of industrial production. But all these elements of the aggregate compulsion rise out of and accompany the evolution of the modern industrial system, which in turn is based upon that progress of civilization, through the work of the inventor, the mechanic and the man of science, which is giving us such marvelous accumulations of material wealth, with all its higher accompaniments in the realms of the sciences, the literatures and the arts, fine, useful and æsthetic. This development gives at once our stimulus and our opportunity.

Perhaps the best index of the magnitude and importance of the demand which the country is making upon the teachers of science for a basis for industrial development is seen in the growth, during the last half-century, particularly, of the profession of engineering, and in *its* characteristic changes, in consonance with the alteration which has taken place in the industrial situation in the last generation. At the middle of the century less than fifty engineers were graduated from schools of this country each year, and those were mainly—nominally, at least—civil engineers, and their principal employment was railroad building. After the close of our civil war the mining and the mechanical engineer began to find a larger place in the industrial system, and during the next years their numbers became, each, one-third as great as the number engaging in civil engineering.* Since that time the number of civil engineers has relatively decreased and the output of mining engineers has been almost stationary; while the number of young men going into the mechanical branch has increased enormously and now considerably exceeds the numbers in the oldest division. The total output for the country is now about one thousand a year, and its growth and the rate of its growth are both continually increasing. Reckoning from 1870, the total gain in numbers is equal very nearly to the square of the number of years elapsing; which indicates a rate of progress parallel with that shown in the curves of the industries generally and of the wealth of the nation and of that of the average citizen.

The deduction which is of most importance in the connection here examined into is that the teachers of the country, and especially the teachers of science and of technical subjects in applied science, may expect some such law to hold in the immediate future and probably for many years, if not for generations, and they thus find here a measure of the responsibilities falling upon themselves, and of the splendid opportunities which are coming to them in the progress of that evolution of the modern "complete and perfect education," and of the realized Utopia that is certainly coming to our successors, in later generations, if only humanity is permitted to stand in the van in the onward march of the world, and to lead, unchallenged, as absolutely as have representatives of a baser kind of man in times past.

The scientific basis of modern industry must hereafter be supplied by the engineering and trade schools, and the sciences must hereafter become constantly more and more completely the foundation of all industries. The generals of the industrial army must be continually more and more completely and perfectly educated for their work, and more and more cultured, as they become more essentially leaders of men and sources of power. The preparation of youth for entrance into the constructive vocations and professions must be begun in the preparatory schools, and, consequently and obviously, the prosperity of the nation and its place among nations will ultimately be determined largely by the wisdom, the earnestness, the talents and the conscientiousness of the science teachers in our schools. Men of large views, of wise understanding, of unselfish and unprejudiced minds, are now needed, more than ever before, to guide legislators, administrators, people and pupils; and nowhere are they more to be hoped for than among our contemporary science teachers, free from tradition, prejudice and self-interest as is no other class in the community.

It is thus that we find all our curves of progress obeying similar laws and following parallel lines throughout the century, promising hereafter similar parallelisms, through the immediate future, at least, and probably through the coming century. The twentieth century will, we may hope and expect, illustrate precisely as has the nineteenth this mutual interdependence of all stimuli and of all opportunities. Productivity, wealth, all material and intellectual and spiritual progress, we may well believe, will be more and more closely interrelated as time progresses. The revolution, though effecting these wonderful changes in the "Wonderful Century" just past, has but, in fact, only now begun, and the change thus inaugurated remains to be completed in a future, the duration of which we cannot yet surmise, much less predict. The most learned men of our time are, as a rule, not members of the "learned professions," distinctively so called in earlier days, but are found among the teachers of those aristocratic classes and among teachers in all departments of learning, among men of science, philosophers, diplomats and engineers, mathematicians and philologists, jurists and men of achievement, as well as among men of books. The expansion of our colleges is, in these times, mainly on the side of natural science and applied science. All languages and literatures, all mathematics and all ancient forms of learning are now valued both for their disciplinary effect, as of old, and for their helpfulness in the making of the man competent to so employ his gymnastic development as to, in a maximum degree, aid his fellows. As I have often quoted, "It is as easy to go somewhither as to walk around the square" in the acquirement of learning and of all science. Applied gymnastics and ultimate accomplishment of good become the gages of the value of the man, and of his life, in the minds of all who have come completely out of the past into the atmosphere of the contemporary world. Dreams and dreamers are to-day alike ignored.

Thus it happens that our colleges are so rapidly coming to be catholic and universal in their range, and the real test of the desirability of any study therein is now helpfulness to classes hitherto unable to secure opportunity for higher learning in their sections of the intellectual world or in their broadening and elevating professional requirements.

Does any sufficient body of men desire and need this opportunity to acquire learning in this field? This is the real question to be asked and answered by the college, the professional school or the university. We are to-day, in fact, becoming as catholic, and our curriculums as correctly university programmes, as were those of the ancient colleges of the Egyptians at Thebes and of the Greeks at Alexandria—yet it is mortifying and saddening to recognize the truth that two thousand years have elapsed since a true university was planned and organized, and that only now have successors appeared to those pioneers. Even now, they are few in number, incomplete for the time and still subject to obstruction in a multitude of ways. The contemporary Cornellian idea was that of the unknown early Egyptian, of Aristotle, of Des Cartes, of Milton, of the Marquis of Worcester, of many wise men living in the intermediate periods. Of all the nations of our day, only the Germans have systematically followed the Aristotelian idea in its generality and have formally established a national, universal, system of "instruction of any man in any study" as Cornell phrased it; only the French have organized a national university, after the ancient plan, at the capital of the country, and only the United States has a system of primary education aiming at the instruction of all classes and conditions of youth in all the primary studies—universal in its welcome of all the children of all citizens.

France, Germany and the United States thus have each an element of a correct system of education of a people for the life work of a people; but neither has a full, spherical organization of an educational system which provides for the children of all sorts and conditions of men, offers a training in the scientific basis of all modern industries, gives to all youths their choice of paths into the kind of life and work best adapted to the natural talent of each and affords free access into the learned professions for those capable of entering with promise of success. Our common school system requires supplementing by an equally catholic organization of scientific manual training, trade and technical schools, such as Germany has provided, and by development, in college and in university, of the whole scientific basis of all the great industries now demanding firm and deep foundations such as never were required before. Still more, above and beyond the whole university of instruction, is needed provision for extensive research work in all departments of sciences, literatures and arts, in which men of genius and talent shall be given leisure and opportunity to deliberately and fruitfully display their powers in the extension of human knowledge and in opening new paths for the teacher, the inventor, the organizer of industries; accumulating learning for transmission downward to all men capable of profitable acquirement, and use of the fruits of original research and discovery. The whole completed and symmetrized system is to be mainly developed by extension of the sciences and their applications; for the older learning is already admirably presented in the pioneer institutions of learning of all grades.

A noble beginning has been made; but all our newer departments of education are still more or less dependent and mendicant, and must so remain until the State can be induced to provide fully for them—as fully as for primary and secondary education. The Western States are doing something in this direction, and in some cases in a creditable though still incomplete way. The Miltonian "complete and perfect" education cannot be entirely organized, however, until statesmen shall arise capable of appreciating and of effectively inaugurating and liberally sustaining that university which shall comprehend all divisions of the curriculum, furnishing Huxley's ladder, leading from the gutter to the research department of the university, for the son and the daughter of every citizen, whether of high or low degree, if only intellectually capable of climbing it.

While obviously a folly to attempt to utilize "a three-story education in a one-story brain," it will be admitted to be the highest aim of statecraft and social economics to see that every "three-story brain" shall have the opportunity to acquire a "three-story education," and to thus return to the nation a many-fold premium on the investment. One great mind lost to the world through lack of the highest education which it is capable of utilizing is a more grievous loss than sunken fleets. One potential Watt, Faraday, Corliss or Darwin, undeveloped or uneducated to the highest point of vantage, means loss inestimable. One great man at the highest altitude to which he is capable of rising is worth more than any mine; one genius, trained and cultured, out-values a multitude; one statesman, one industrial commander, one great exploiter of scientific knowledge, counts for an army; for he makes effective an army, saves a country from ruin, raises a nation to unimagined heights, confers the comforts of the highest civilization upon the people or gives his fellowmen leadership toward hitherto unexplored realms of wisdom, knowledge and opportunity. The grandest financial expenditures by the State are those which develop new moral, intellectual and physical forces for the benefit of the nation.

* Trend of National Progress; R. H. Thurston; N. A. Rev., Sept. 1895.

† American Competition; R. H. Thurston; London Engineering, Mch. 30, 1900.

‡ Ibidem. Also Trend of National Progress. Super.

* Technical Education in the U. S., R. H. T.—Trans. A. S. M. E., 1883.

A "complete and perfect" system of education of the people thus provides largest, richest, best returns. What we term technical or professional education is that highest form of preparation for life-work in highest fields which constitutes the noblest kind of apprenticeship, and the science teacher's task is an essential element of this preparation of the citizen for the grandest task of our time, which is the approximation of our methods and of our intellectual product to the ideals of Aristotle, of Hero of Alexandria, of Leonardo, of Des Cartes, of Comenius, of Paley, of Bacon, of Milton, of Worcester, of the great French scholars and the great German statesmen of our era, to the ideal of Cornell and to the highest and noblest ideals of all our own greatest men, from Washington and Jefferson and Lincoln to Wayland and Walker and Cornell and Andrew D. White. It means the universal completing and perfecting of the citizen, educating with due regard to his capacity; so that, as Milton expressed it, he may "perform justly, skillful and magnanimously all the offices, both public and private, of peace and war." To-day the opportunities, the duties and the victories of peace, rather than war, direct our judgment and our work and involve the useful employment of all arts and sciences, the utilization of all literatures, of every mental and physical talent and of all the available energy of the man. In all this science must hereafter perform a vastly higher and more fruitful part than ever before; and her duties will become more and more fruitful and ennobling and helpful to teacher and pupil alike as the years go by, and as the new century reveals its many and mighty tasks to us all.

PHOTOGRAPHIC NOVELTIES.

AMONG the photographic novelties that have recently made their appearance, there are a few worthy of mention by reason of their entirely new arrangements. The "Photo-Cartouche" (Fig. 2) is a twin lens camera devised by M. Schlesinger and constructed by M. Gilon. It is of the usual form, with a drawer-magazine for the manipulation of the plates; but what chiefly characterizes it is the manner in which the charging is done. The plates are, as usual, put into small metal holders, but the latter, instead of being placed directly in the drawer, are laid one upon another in a box, *D* (No. 4), which is provided with no mechanism, and which constitutes the "cartouche" (cartridge). The operator may provide himself with a certain number of these boxes, and thus be able to recharge his apparatus in broad daylight. The box, in fact, is completely closed on every side, but after it has been placed in the drawer of the camera the slides that form the top and bottom are removed, and the plates, *P* (No. 3), thus freed, engage with what may be called the extracting mechanism, housed in the drawer. Two clamps grasp the top plate (the one that has just been exposed), and when the handle is pulled the plate engages with two levers which guide it to the bottom, *B*, whatever be the position of the apparatus; so that when the handle is shoved back the plate passes under the others in the box. After the twelve plates have been exposed the box is closed by means of the slides, which have been temporarily resting in a recess formed for this purpose in the bottom of the apparatus. It is then possible to take out the box in broad daylight and substitute another for it. This arrangement allows one to consider the magazine as indefinite, since the number of plates is limited only by that of the boxes that may be inclosed in its pockets or in a special bag. These boxes are not very costly, owing to the fact that they are destitute of mechanism.

The shutter (No. 2) is likewise worthy of special mention by reason of the manner in which the time of exposure is regulated. It is a shutter with two slides, *L*, one moving over the other and not unmasking the objective when set. It permits of making any length of exposure at will. The retardation of speed is regulated by a fly, *H*, which revolves as in clockwork movement, and regulates the velocity of observation according to the length of time that it is capable of revolving. In this way a very accurate determination of the time of opening of the objective is reached, and it is possible to obtain a certain and invariable graduation. This cannot be done with shutters in which the velocity is regulated either by the greater or less tension of a spring, or the more or less energetic friction of a brake.

The opening and closing of the objective always take place abruptly, whatever be the velocity for which the apparatus has been regulated. The focusing is done through the displacement of the board that carries the objective-mounting by means of a button, *M* (No. 1), that acts upon a rack. A special jointing assures an absolute immobility of this part of the apparatus, even when it is advanced as much as possible for focusing at more than three feet.

The putting out of center is not effected, as in other apparatus, by the displacement of the objective, but by that of the magazine, *M*, in its entirety. This permits of the use of a special finder, *V*, which always gives the image contained in the plate without the need of any regulation, whatever be the displacement. This arrangement requires a divergent lens having the same focus as the objective employed and linear dimensions exactly half those of the plate. It therefore occupies considerable space, and in order to conceal it when not in service it became necessary to place it toward the back of the apparatus immediately in front of the magazine, upon the body, *A*, of the camera, upon which it can be turned down. It is operatively connected with this part of the apparatus, and consequently remains immovable, its optical axis corresponding to that of the objective. The eyehole support, *R*, that corresponds to it is, on the contrary, mounted upon the magazine and moves therewith in cases of displacement. It is provided with a slide that permits of placing it at a distance from the lens equal to the focal distance of the objective. All those who have made use of hand apparatus will at once see how great an advantage there is in being able so easily to see upon a large finder the exact image that will be reproduced in the negative.

The Guenault Adapter (Fig. 1) is designed to convert the folding Kodak into an apparatus for plates. Although the use of the film is now quite practical, it is nevertheless attended with certain inconveniences, especially when employed in a roll, and among these is the necessity of utilizing the entire roll before the developing is done. This drawback is compensated for, however, by lightness and compactness.

Therefore, without criticising the folding Kodak, we think that it is capable of some improvement, and that many amateurs would be pleased if it could be employed with glass plates. M. Guenault has rendered this possible by so arranging things that the transformation to be made is so simple that anyone can effect it without having recourse to a workman. His adapter is a small metal case, *E* (Fig. 1), which is applied by hard friction to the rear frame of the Kodak, the cover, *A*, of which has been removed. It is into this case that slides the small metal frame, *B*, provided with a shutter that is removed at the moment of operating. Three of these frames are furnished with the adapter.

The sensitized plate is no longer exactly at the place where it should be in order that the objective may be in focus upon infinity, but is in focus for objects situated at a distance of five feet; and if it is desired to photograph objects situated at three feet, a frame, *F*, is interposed between the case, *E*, and the Kodak. It is naturally necessary, also, that one shall be able to operate without concerning himself about the distance—that is to say, with the focus upon infinity. To this effect, it is necessary to bring the object near the sensitized surface. After some experiments, the inventor has adopted a very ingenious automatic arrangement, which is represented apart, at the bottom of the engraving. It consists of a small plate of steel, *c*, bent at right angles and held, through the intermedium of the counterplate, *H*, by the wooden screw, *V*, which is found on all Kodaks. Anyone can perform this operation very easily, the only tool necessary being a screwdriver. This plate is designed to be interposed between the jointed levers that support the front, *D*, of the apparatus, so that they shall not be fully extended. The objective is thus moved backward to such a distance that the focusing shall be exact. If it be desired to operate with a film wound upon a spool, or if it be desired to photograph an object situated at a distance of five feet, it suffices to raise the plates slightly. By means of these small accessories, which are not very costly, we have an apparatus with which glass plates as well as films in rolls may be employed.—For the above information and the engravings we are indebted to La Nature.

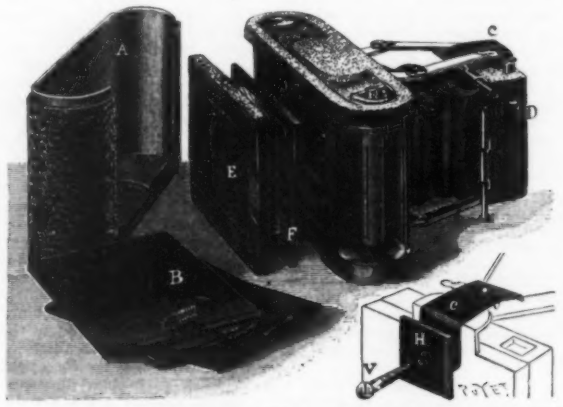


FIG. 1.—GUENAULT ADAPTER FOR CONVERTING THE KODAK INTO AN APPARATUS WITH SEPARATE FRAMES.

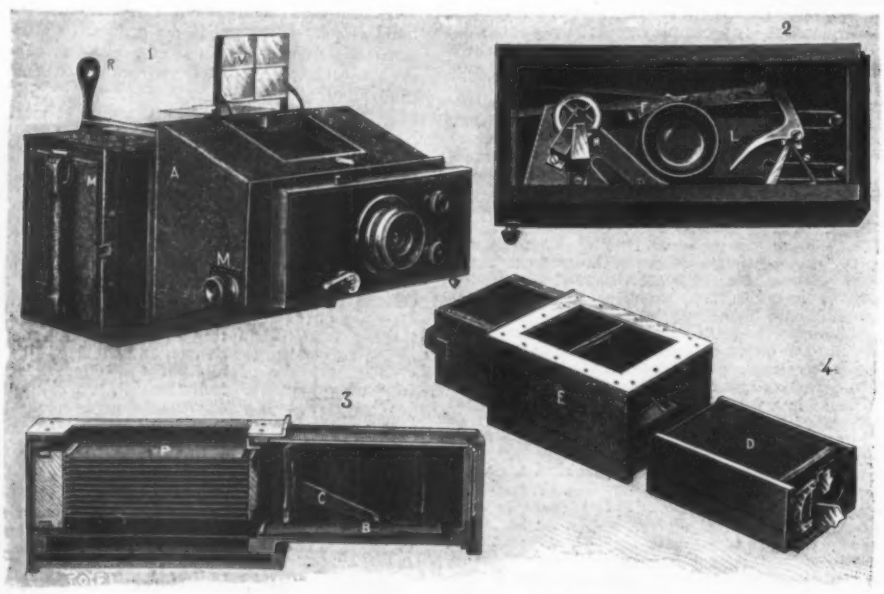


FIG. 2.—"PHOTO-CARTOUCHE" CAMERA.

1. General view of the apparatus with the finder raised and the magazine out of center. 2. Mechanism of the shutter. 3. Change of plates in all positions. 4. Plate box.

STANDARD SILVER: ITS HISTORY, PROPERTIES, AND USES.—I.

BY ERNEST A. SMITH, Assoc.R.S.M., F.C.S.

AT a very early period of the world's history silver was used as a medium of exchange, and also for domestic and public purposes.

Gold and silver appear to have been in general use as money from the time of Abraham, while vessels and ornaments of the precious metals were common in Egypt in the times of Usertsen I. (about B. C. 2433) and of Thothmes III. (about B. C. 1600), the contemporaries of Joseph and Moses.*

In ancient times the metals were used in their native or unalloyed condition, but alloys of definite composition or standard alloys were adopted for the purpose of coinage and also in the arts as early as B. C. 500, and probably earlier.

"The reasons for the use of alloys, in preference to pure metals, are somewhat complex. In early states of civilization coins are generally made of more or less pure metal, but a nation does not advance far in its history before the very important fact is recognized that alloys are more durable than pure metals, and that their substitution for pure gold or silver affords a notable source of revenue.

"In cases where the coinage is in any degree international, the adoption of a low standard by one nation has to be followed by neighboring nations in order to prevent loss, and to facilitate commerce by avoiding the necessity for tedious calculations as to the rate at which coins may circulate in the respective countries."†

With regard to the actual standards of fineness or amounts of precious metal present in any given alloy which have, from time to time, been employed, it may be remarked that in the numismatic history of the world endless combinations of precious and base metals have been represented.

Gold and silver, on account of their comparative softness and flexibility, are never employed in a pure state, but are almost universally alloyed with a certain proportion of copper, the alloys being made up to definite proportions or "standards."

Although it is generally known that silver coins and plate are not made of pure silver, few people have very definite ideas as to the composition of the alloys which are employed for these purposes, and still fewer are aware that the amount of base metal added to the silver is guarded with the most rigorous care.

In the British Isles the proportion of silver in coin and plate is regulated by law. It is enacted that British silver coin and plate shall consist of 11 ounces 2 pennyweights of fine or pure silver and 18 pennyweights of copper in the troy pound, or 925 parts of fine silver per 1,000 parts of alloy. This is termed sterling silver, and was first particularly defined by statute in 1576 (18th of Elizabeth, c. 15).

* Wilkinson's "Ancient Egypt," III., 225.

† Roberts-Austen, Cantor Lectures on "Alloys for Coinage," Society of Arts, 1884, p. 14.

Many derivations have been offered with regard to the word sterling, but the most probable and the one now generally adopted is that given in a well-known old book, entitled "A New Touchstone for Gold and Silver Wares," published in 1679. In this very interesting work the author states (on page 8) that the expression sterling-alloy is derived "from the Easterlings, or men that came from the East part of Germany, in the time of King Richard the First, and who were the first contrivers and makers of that alloy." The purity of their money was famous, and it is supposed that coiners were fetched from Eastern Germany to improve the British currency.

Stow, writing in 1603,* gives a similar explanation. He says: "The money of England was called of the workers thereof, and so the Easterling pence took their names of the Easterlings, which did first make this money in England in the reign of Henry II., and thus I set it down according to my reading in Antiquitie of money matters, omitting the imaginations of late writers, of whom some have said Easterling money to take that name of a starre stamped on the border or ring of the penie; other some, of a bird called a stare or starling stamped on the circumference, and others (more unlikely) of being coined at Stiruelin or Starling, a town in Scotland."

With regard to the adoption of an alloy containing 11 ounces 2 pennyweights of silver in the pound troy as a standard for the silver currency of this country, Sir Roberts-Austen† has pointed out that the adjustment of the relative proportions of the precious and base metals is undoubtedly guided by the particular system of weights used.

The fineness of alloys of silver has from very early times been computed by divisions of the troy pound, which weight is still retained in weighing gold and silver.

The Commissioners appointed in 1868 to inquire into the condition of the Exchequer Standards‡ state that "the troy pound is said to have been derived from the Roman weight of 5,759.2 grains, the 125th part of the large Alexandrian talent, this weight, like the troy pound, having been divided by the Romans into twelve ounces," and they add, "the troy weight is universally allowed to have been in general use from the time of King Edward I. The most ancient system of weights in this kingdom was that of the moneyers' pound, or the money pound of the Anglo-Saxons, which continued in use for some centuries after the Conquest, being then known as the Tower pound, or sometimes the goldsmiths' pound. It contained twelve ounces of 450 grains each, or 5,400 grains, and this weight of silver was a pound sterling. The Tower pound was abolished in 1527 by a statute of King Henry VIII., which first established troy weight as the only legal weight for gold and silver. From that time to the present our system of coinage has been based on the troy weight."

In connection with the standard 925, it may be remarked that a Roman silver coin of the Triumvir Antoninus§ (B. C. 31) had almost the same composition as British silver coin, as it contained—silver 925, copper 71, lead 2, and gold 1.

The standard 925 was probably first introduced into England by the Saxons, as the Saxon pennies were of the same standard. A number of coins issued before the Norman Conquest have been assayed by Roberts-Austen,‖ from which the following results have been selected. A coin of Burgred, King of Mercia (852-874 A. D.), contained only 332 parts of silver in the thousand, while one of Ethelred (978-1016 A. D.) contained 918 parts of silver, and was probably intended to represent the standard 925. A coin of Canute (1016-1035 A. D.) proved to be of the standard 931, and was also intended, in all probability, to represent the English standard.

Anglo-Saxon and Anglo-Norman coins are believed to have been of the standard 925; a coin of William the Conqueror when assayed proved to be of the standard 922.8. In England the standard 925 appears to have remained unchanged until the thirty-fourth year of King Henry VIII. (A. D. 1542), when, as will be seen from the following table, a great fall in the fineness took place:

TABLE SHOWING THE ALTERATIONS IN FINENESS OF ENGLISH STANDARD SILVER, FROM THE REIGN OF WILLIAM THE CONQUEROR TO THAT OF EDWARD VII.

Date.	Reign.	Fineness of Silver.		
		In the Pound Troy.		Parts per 1,000.
		ozs.	dwt.	
1066 to 1542	William I. to 34 Henry VIII.	11	2	925
1545	36 Henry VIII.	10	0	833·3
1546	37 Henry VIII.	6	0	500
1547	1 Edward VI.	4	0	333.3
1549	3 Edward VI.	6	0	500
1550	4 Edward VI.	3	0	250
1551	5 Edward VI.	5	0	416.6
1552	6 Edward VI.	11	1	921
1553	1 Mary	11	0	916.6
1560 to Present Time	2 Elizabeth to Edward VII.	11	2	925

The table shows that in 1545 the standard alloy contained only one-half of its weight of pure silver, and in 1550 it was still further debased, and contained only one-fourth part of pure silver. The restoration of the silver standard, begun in the reign of King Edward VI., was completed by Queen Elizabeth, and it has not been since debased.

(To be continued.)

* "A Survey of London," by John Stow, p. 52, 1603. Quoted by Roberts-Austen, p. 14, Ibid.

† Ibid., Cantor Lecture, p. 15.

‡ Third Report of Commissioners, Parliamentary Paper, c. 30, p. iii., 1870.

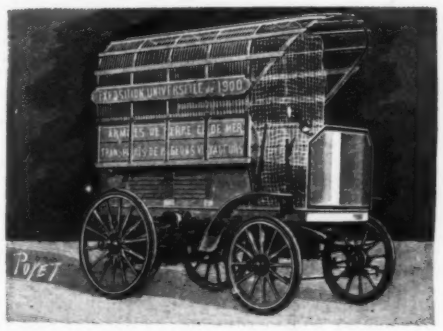
§ "Die Metallurgie. Metallverarbeitung." A. Ledebur, p. 86, 1882.

‖ Ibid., Cantor Lectures, page 17.

AUTOMOBILES IN THE ARMY.

A NUMBER of interesting tests were recently made at Turin under the direction of the officers of the General staff of the Italian Army, with regard to the application of automobiles to military service. From these experiments it has been proved undeniably that steam automobiles are destined to render great service for the transportation of heavy loads. As to light machines, especially for the carriage of personnel, it was found that gasoline and electric vehicles will prove of great value in military operations, although the latter must for the present be excluded from the active service of the troops on account of the difficulty of finding charging stations along the route. Upon the whole, the results are quite favorable to the use of the automobile in the army.

The French army, too, is actively engaged in experimenting with this mode of locomotion, and has recently put in service several new types of vehicles,



AUTOMOBILE CARRIAGE FOR THE CONVEYANCE OF CARRIER PIGEONS.

such as steam carriages for the conveyance of provisions, high-speed carriages for the transmission of orders, and carriages for the conveyance of carrier pigeons. One of these latter, which was exhibited at the recent Salon de l'Automobile, is represented in the accompanying engraving, which we borrow from our French contemporary, La Nature.

The question of automobiles for army use has not received the same attention in England that it has among the other nations of Europe. It is, however, under favorable consideration by the authorities.

MILLING MACHINE.

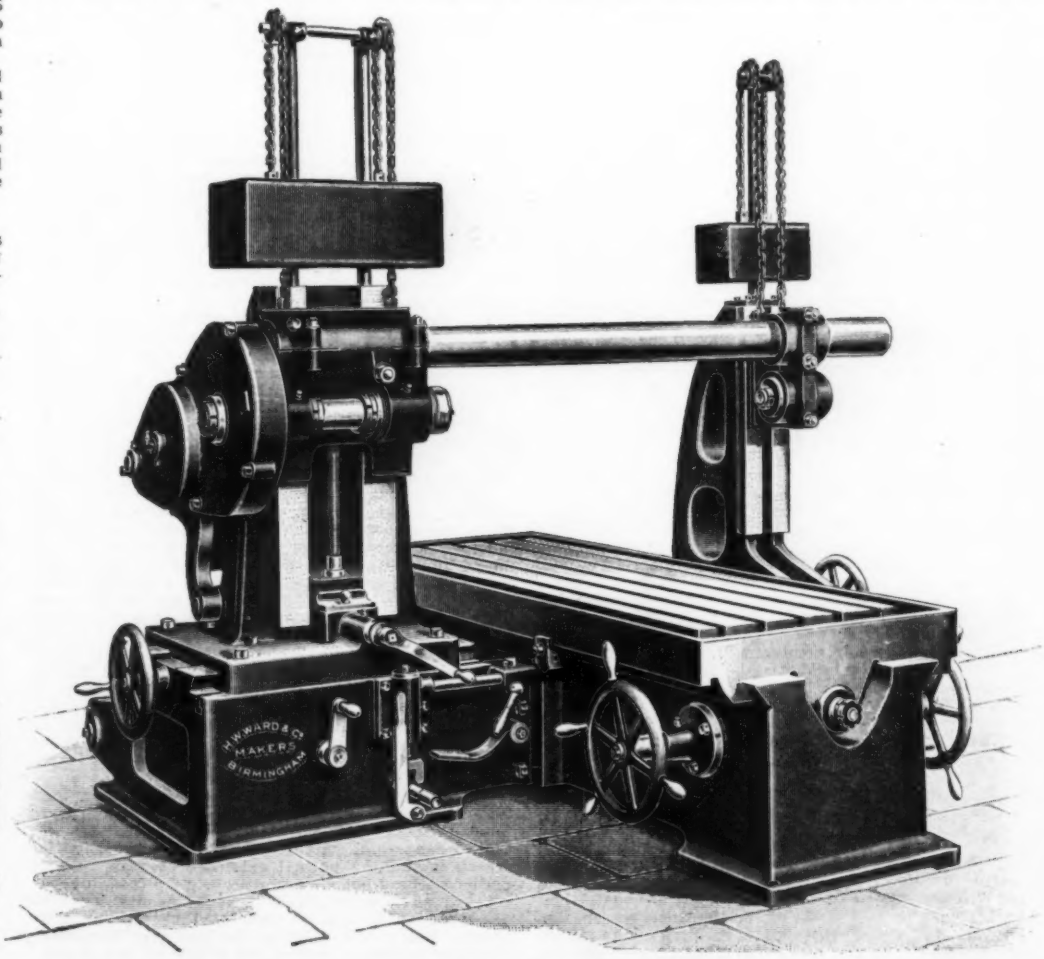
WE illustrate, says Engineering, a milling machine which is now being put on the market by Messrs. H. W. Ward & Company, of Lionel Street, Birmingham, England, and is intended more especially for use in the electrical trades, though, of course, it is equally suitable for much general engineering work. The general character of the machine is very clearly shown in our engraving. The bed of the machine is a heavy box casting, having bolted to it the two wings, which carry respectively the head slide and the "steady." Both the latter are adjustable at right angles to the table by means of handwheels and screws, as is clearly shown in the case of the head slide. The vertical traverse of the head is obtained by means of screw and bevel gears. The spindle is driven by means of a 4-inch belt and intermediate gears, the ratio of which can be altered at will from 9 to 1 to 27 to 1 by merely moving over a lever. The feed of the table is driven by a four-speed cone at the foot of the machine and is fitted with reversing gear. By moving a lever the rate of traverse can be trebled when desired. On depressing a foot lever the table is returned at a quick speed. The clutch giving this quick return falls out of gear immediately the pressure of the foot is removed, and it is impossible for the quick return and the feed motion to be in gear simultaneously. When desired the table can be shifted by hand, a wheel being provided for this purpose near the front of the machine, as shown. An automatic trip throws the feed out of gear at any point of the table's traverse, the action being instantaneous and independent of the direction of the feed. There are two countershafts, arranged in such a way that the feeds may be altered independently of the spindle speeds. The principal dimensions of the machine are as follows:

Traverse of table	6 feet.
Size of table	7 feet by 2 feet 4 inches.
Cross movement of head and steadies	6 inches.
Distance between heads	4 feet 8 inches.
Floor space required	14 feet by 9 feet 6 inches.
Spindle	3½ inches.
Maximum height of spindle above table	24 inches.
Total power of gear in head	27 to 1.

STATUES FROM THE SEA.

DR. RUFUS B. RICHARDSON, director of the American School at Athens, describes the discovery of bronze and marble statues in the sea south of the Peloponnesus, says The American Antiquarian. This occurred some time in January. The statues are now in Athens. Among the fragments of bronze statues were three right feet and one left, on which were sandals with straps around the feet; also several forearms and hands with the straps of the leather boxing-glove around the wrist. Besides these were found a marble hand of good technique, holding a mantle; also the head of a small bronze lion and another of a dog. There were three bronze statuettes about a foot and a half in height, and a great bronze statue more than life size. The right arm is extended, the forearm bending slightly to the front, while the left falls slightly to the side without touching the body. The beauty of the head surpasses all other excellences of the statue. The symmetry of the lines of the face and the regularity in general of all the features manifest the perfection of the work. The heroic size of the figure indicates that it represents some god—Apollo or Hermes—and it is said to be an original work of the fourth century B. C. It seems as if a studio existed in the miraculous depths, a studio like those of Phidias and Praxiteles. The following is the comment upon it:

"We are in the presence of a great event for art. The discovery of this statue may mark an epoch, since even the material of which it consists—bronze—makes the find a rare one. Of the works of Greek art only those in marble have been preserved, because they furnished greater resistance to the ax and could not be used and sold as those of metal could. Only wonders of nature have hitherto saved for us bronze monuments of Greek art from the covetousness of barbarism and time. The fire and lava of Vesuvius pre-



MILLING MACHINE.

served for us those masterpieces of bronze in the Naples Museum, the only collection of its kind in the world. Now the sea off Anticythera saves for us other bronzes, coming who knows whence, which, had they gone to Rome, must have undergone the same destruction at the hands of Christians and barbarians, who choked and annihilated Greek art. And who knows what is yet to be found, how many surprises the jealous sea still guards for us? The first foundations of the treasure have been laid. Two statues of unrivaled excellence have been found, and the miraculous depths, according to the expressions of the divers, have still 'a world of things.' Every day a new god or a new hero, a new wonder of art, may be brought up to the light to receive again the worship of lovers of the beautiful."

DR. METCHNIKOFF ON MICROBES AND THE HUMAN BODY.

A special meeting of the Manchester Literary and Philosophical Society was held on Monday, April 22, when Dr. Elie Metchnikoff, of the Pasteur Institute, Paris, delivered the Wilde Lecture. Before the lecture the president of the society (Prof. Lamb) presented the Wilde Medal for 1901 to Dr. Metchnikoff, and the Wilde Premium for 1901 to Mr. Thomas Thorp, says Nature.

Dr. Metchnikoff's lecture, which was in French, was on "La Flore Microbienne du Corps Humain." Dr. Metchnikoff explained that men were free from microbes at birth, but immediately after birth the surface of the skin and the mucous membranes became peopled with them, and at the end of some days they were numerous and varied. Their germs were derived from the air, or from the water used in washing the child. In summer they developed faster than in winter, and sometimes within four hours after birth there would be found several different sorts of microbes in the intestines. But as a rule their appearance was first observed between the tenth and seventeenth hour after birth. The habitation preferred by the microbes found in the skin was unquestionably the capillary follicles, a kind of deep sheath for the formation of hair. The mucous membranes, the surface of which was always moist and covered with substances by which microbes were readily nourished, were generally supplied with them more abundantly than the skin. The conjunctiva of the eye, however, thanks to its being continually washed by tears, usually rid itself of most of the microbes that found their way into the eye either with the fine dust in the air or through contact with the fingers. There was no doubt that microbes penetrated into the very deepest parts of the respiratory passages, though it was difficult to give a precise account of those ordinarily inhabiting the windpipe, the bronchial tubes and the lungs, since the presence of those which are found there after death might be explained by the intrusion, after death, of microbes from adjacent organs of the body. However that might be, the growth of microbes in the lower respiratory passages ought never, in a healthy man, to be great.

It was the digestive organs that exhibited them in the greatest abundance. Dr. Miller, of Berlin, has described more than thirty species inhabiting the cavity of the human mouth, some of them also to be found on the human skin; others, which were found about the teeth, were peculiar to the mouth and were not met with anywhere else. Several of the species characteristic of the mouth made their way deep into the digestive organs and were recognizable in the stomach and the intestines. The stomach, with its acid contents, offered conditions affecting in a quite exceptional way the development of microscopic growths. Many kinds of bacteria could not endure an acid environment; still, the bacterial system of the human stomach was pretty rich, thirty different species having already been distinguished, most of which were not found elsewhere in the digestive system. In the stomach and still more in the small intestine, bacilli were the predominating form of microbe, the number and relative proportions of microbes in the small intestine varying with the food eaten. Meat and vegetable diets respectively stimulated the development of special bacterial forms, though even when the diet was unaltered noteworthy fluctuations in the microbian population were observable. From the smaller intestine the microbes passed to the larger, where they were joined by a great number of new kinds. Of all the parts of the human body, the large intestine was undoubtedly the most abundantly teeming with these growths. It was inhabited by about forty-five species of microbe, chiefly bacteria, among which bacilli were much the most numerous. The larger intestine began to be inhabited immediately after birth. Even on the first day of life, before any food whatever had been taken, a fairly great variety of microbes was to be found there. When the child was suckled the population of the large intestine very soon underwent a change. It became more uniform and was composed mainly, and sometimes almost exclusively, of a particular bacillus. In children fed with the bottle, on cow's milk, this bacillus was found, too, but in smaller numbers, the large intestine in these children being much richer in microbes of various types. After weaning, the abundance of microbes became much greater still. The number of distinct species of microbes to be found in a man in health could not be exactly estimated, but quite roughly and provisionally might be put between sixty and seventy.

What could one say of the function of these varied growths? Among invertebrate animals there were some covered with much more copious growths than were found on the human skin. On the southern and western coasts of England there was found in great numbers a kind of crab whose whole shell was generally covered thickly with vegetable growths. Their use was obvious. They assimilated the crab to the marine vegetation, and made him invisible alike to his enemies and to his prey. No such demonstration could be given of the utility of the microbes on the human skin. On the other hand, the flora of the cavity of the mouth might render man a service. Everybody had noticed that wounds inside the mouth healed much sooner than those on the outer skin. Moistened by the saliva, the wounds remained in contact with the microbes and their soluble products, which stimulated in a marked degree the reaction of the human organism. The secretions of the microbes attracted a great number of white blood corpuscles, which cleaned the wound, cleared it of microbes and mortified tissues, and so favored the process of recovery. In the lower parts of the digestive system this function of microbes was less important, the mucous membrane there being much more seldom torn. But it was probable that the acids secreted by many bacteria in the small intestine rendered a real service by preventing the development of certain other microbes which might impede digestion. This preventive function was manifested also in the course of conflict between the human organism and microbes of a very dangerous kind, and there was reason to believe that in some cases the germs of Asiatic cholera were rendered innocuous by the action of the microbes which they encountered in the intestines. It had also been contended by some authorities that the microbes in the digestive system played an important part in the digesting of food, and that without them food could not be assimilated; but the data available would lead rather to the general conclusion that for the normal action of the human digestion the presence of the intestinal microbes was by no means indispensable.

They should now try to ascertain whether the microbes in the human system might injure its health. When the defensive forces of the body flagged, whatever might be the reason, the microbes on the skin began to multiply and to pour their noxious products into the tissues and the blood. It often happened that serious boils and anthrax developed themselves in persons suffering from diabetes or some other general disease, their cause being, not the introduction of a morbid germ from without, but the excessive multiplication of certain microbes which are found in the healthy human skin and which now took advantage of the enfeeblement of the defensive cells. But the greatest harm was done by the microbes of the stomach and intestines. It had been recognized that the gravity of the danger incurred in cases of perforation of the intestines was due to the inflammatory action of the microbes that escaped into the peritoneum. Nor was the injurious effect restricted to cases where the microbes penetrated directly into the other organs or into the blood, for the microbes produced soluble substances which could be absorbed through the wall of the intestines and so make their way into the circulation. Several of these were substances more or less poisonous in their action, and it was very probable that a great many of these toxic products of our intestinal flora had still to be ascertained. In spite of our imperfect knowledge, there was reason to state, with the greatest strength of conviction, that the poisons produced by the intestinal microbes played a considerable part in causing many and various maladies. Headaches, exhaustion, neurasthenia, dyspeptic asthma, certain forms of epilepsy, several skin diseases, including acne, had by certain authorities been attributed wholly or in part to the action of poisons originated in the digestive system. Even in cases of mental disease its importance could not be denied; it had a noteworthy connection with diseases involving atrophy of the higher organs, such as the brain, the heart, the kidneys and the liver.

Dr. Metchnikoff then discussed at some length the relations of the normal microbian population of the human body—that is, the microbes present in it in a state of health—and the pathological microbes, or microbes directly inducing specific disease. He pointed to the methods practised in medicine and surgery to limit or counteract the action of microbes ascertainedly or potentially generative of disease, and to what he believed to be limitations to the beneficial operation of antiseptics. There was a tendency to renounce more or less completely the use of antiseptics, and to have recourse more and more to simply mechanical measures for keeping microbes out of the body—the prolonged washing of the hands, for instance, or the moistening of the conjunctiva of the eye and other mucous membranes with liquids not strong enough to injure the living cells of the skin. The best method of antiseptic treatment of the intestine, merely relative as its efficacy might be, was now recognized in the use of drugs which produced frequent and abundant evacuation.

How were we to square the conviction that so many of the microbes usually found in the body were injurious with the argument, drawn from the work of Darwin, that if our microbes are so dangerous they ought long ago to have been eliminated simply by the operation of natural selection? One observed constantly that not merely natural characteristics unfavorable to their possessor's life, but even organs which had merely ceased to be useful to him, disappeared more or less completely. To bring out more clearly this paradoxical aspect of the survival of our microbes, most of which were not merely useless but unquestionably injurious, he would draw attention to the fact that the very organs of the body which sustained this flora were themselves for the most part either useless or injurious to health and life. They would remember that the ducts of the capillary follicles in the skin were the seat of a microbian vegetation often composed largely of microbes capable of producing more or less serious disease. Well, those follicles were useless organs, and represented merely what was left of the hair that covered the skin of animals who were our ancestors. In the digestive apparatus of man, the part of the body richest in microbes, there were also to be found parts which, to say the least of them, were now useless. The vermiform appendix, for instance, was the remains of an organ which was more fully developed in our animal forefathers; in the anthropoid apes it was already found in the process of reduction. Even the stomach, that organ which might seem so indispensable for digestion and the normal existence of man, was in reality nothing but a large reservoir for food, a reservoir which could without serious inconvenience be dispensed with. There were at that moment four persons living without stomachs, and thus furnishing a strong argument against the utility of that organ.

Of all the parts of our digestive system it was certainly the small intestine alone that was indispensable to the continuance of life. And yet in man, who could support himself on food easily digestible, the small intestine was disproportionately fully developed. Instead of having it between 18 and 21 feet long, man might do with one-third of that length. Kukula reported a case in which he had removed almost two-thirds of the small intestine with the greatest advantage to the patient. In one case Körte had removed, together with part of the small intestine, the greater part of the large intestine, leaving only the terminal section. As a result of this operation the patient had been completely cured. He could cite other cases of successful surgical operations to prove the uselessness of the large intestine to human beings. In one case the whole of the large intestine had atrophied of itself, without operation, in consequence of a fistula, without interfering with the active life of the subject. The sum of all this was that we possessed a voluminous and highly developed organ, the large intestine, which fulfilled no useful function and bred a very copious and varied mass of microbes, capable of injuring us through their poisons.

In face of this fact it remained to ask what the large intestine was, what is origin and the reason of its existence. The history of the capillary follicles was comparatively simple, for they were the surviving traces of hair which had protected from the cold the animals from which man was descended. The large intestine, on the contrary, was no mere relic, but an organ highly developed. It was, as a rule, found only in the mammiferous animals, and not in birds, reptiles, or others of the lower vertebrates. Dr. Metchnikoff went on to trace in some detail the development of the large intestine to the prevalence of certain special conditions in the life of herbivorous vertebrate animals capable of running at great speed, conditions no longer present in the life of their descendants, and no longer calling for the peculiar organization developed to meet them. The slow tendency of evolution to bring about the atrophy of such organs or characteristics might, however, be assisted by medicine and surgery, medicine coping more effectually with the noxious microbes and their effects, while the progress of surgery had already brought it within its power to remove by operation organs or parts of organs propitious to the growth of the "flora."

Dr. Schunk proposed, and Prof. Hickson seconded, a vote of thanks to the lecturer, and the resolution was carried by acclamation.

BLACKFOOT AMUSEMENTS.

By John Maclean.

On the banks of the Old Man's River, in the days of the buffalo, the lodges were often pitched on the summer evenings, and as the river ran lazily onward there came floating on the breeze the songs of the natives with their merry lilt and sonorous strains. As the male band beat on the tom-toms sitting in the center of the group of men and women under the trees, the deep bass of the male singers mingled in harmonious sweetness with the voices of the women. From four to six men beat their separate tom-toms, and led in the singing. The bodies of the players swayed in unison with the music. The words of the native songs are few, each verse consisting of one or two words repeated. Some of the songs seem to consist solely of the music with the exclamation, Hai-a, Hai-a. There are songs of love, with their amorous music; lively tunes which cheer the heart and compel the singer to sway his body, as he thinks of the dark-eyed maiden in the lodge. The war songs have martial music, deep and strong, arousing the passions and quickening the soul with the promise of victory. The medicine man sings his incantation chant to drive away the spirits which are troubling the patient and to attract the gods of the prairie, who will aid the performer in overcoming the disease. The lodges are lit on the winter evenings with glowing fires, and as the gambling parties sit in the lodges the players sing their gambling songs, invoking the aid of their familiar spirits to insure success. You can distinguish the song of the gambler from that of the medicine man by the lively strains of the former and the low, monotonous chant in the sick lodge. The lonely rider sings his loudest and merriest lays as he rides on his cayuse across the prairie, and the native concert, with its orchestra of drums and the voices of men and women, charms the ear and enlivens the heart with the swing of the music. At the Sun Dance the medicine man in his bower chants his grave petitions in measured tones. The old man or woman sings an impromptu song in memory of the hero of the hour, and all the company within the Medicine Lodge sends forth a mighty volume of song in honor of the day or to commemorate some stirring events in the history of the tribe. I learned from my friend Jerry Potts, the native interpreter, who was highly esteemed by the Indian and white people, that there existed a historical song, similar to the song of Hiawatha as recorded in The Iroquois Book of Rites, and the only person who knew it was Manistokos. Before I was able to secure this important record of the Blackfeet, the aged chief died, and I was never able to verify the statement of the interpreter. The Blackfoot Coronach saddens the heart of the listener as he catches the strains from the lips of a woman or an aged man, for it speaks of death. The plaintive cry of the bereaved is the expression of the pent-up emotions, and as the name of the deceased is uttered in the song of death, and the hunger of the heart yearns for the return of the departed, it seems like a song from the other world.

At the various native feasts large quantities of tea are drunk until the beverage becomes intoxicating. Attracted by hearty singing in one of the log buildings in the camp of Medicine Calf, I entered and sat down on the peeled log which formed the front part of the bed. The company consisted of old men, and the feast was similar to a social gathering for music and conversation with refreshments. Some women brought in pails of tea hung on long poles borne by two, and when these were deposited in the center of the building, one of the women took a pail and a tin cup and passed along in front of each member of the assembly. Following the custom, I took the cup, and dipping it in the pail drank the contents and handed it back to the woman. It was tea, pure and simple, without milk

or sugar, and it was not unpleasant to the taste. Pail after pail was emptied until the twenty-five men had drunk from twelve to twenty cups each, and then hilarious through the influence of the beverage, the songs waxed louder and the tales of heroism became more exciting. A blind warrior related his adventures with the Sioux, and as he fought again the battles of other days, he raised his voice, smote his hands together and trembled with delight. The listeners clapped their hands and shouted, and I must confess that I was not a silent listener, for I could not help expressing my delight at the courage and success of the aged brave. Sometimes these tea feasts ended in a dance, but on this occasion the brave men told their experiences on the field of battle, and then some one would start a song, which would be taken up by the whole company.

There are numerous dances engaged in by the people, the most notable being the Beaver Dance, the Bull Dance, the Pipe Dance, the Buffalo Dance, and the Sun Dance. The Buffalo Dance was an important event previous to the advent of the white men, when the natives were wealthy and proud, but in later years it has been shorn of its glory, and is now a begging dance or a social circumstance. In all the dances the sexes danced alone. In this particular dance the bodies of the men were painted with various devices, some of them relating to the status of the wearer, and others without signification.

A group of warriors drove into the old police fort at Macleod one morning, followed by some women with *travailleux*. The horses and men were grotesquely painted, and as they advanced they made known their presence by shouting in the air. Having tied their horses in convenient places, and selected a level spot in the center of the fort, the women formed a ring by themselves, four men with tom-toms sat apart, and the native spectators sat in a circle, among whom were the dancers. So soon as the quartette band opened the proceedings by beating upon their drums, the men and women all joined in the singing, and three or four men sprang to their feet, and danced heartily, shouting as they lifted their feet from the ground. These men were dressed in Buffalo hides with the skin and horns fastened upon their heads, and after shouting and leaping to their own satisfaction, one by one they sat down exhausted, and others took their places. The movements of the dancers were very grotesque and irregular, consisting of leaps in the air, the raising of one foot and then another, and contortions of the body, accompanied by shouts. This dance was probably learned from the Sioux Indians. In one of the famous war dances of the Blood Indians the drum which was used to arouse the martial spirit of the warriors was purchased from the Sioux.

Gambling is a native propensity. Night and day small groups of men or of women may be found in the lodges playing cards for stakes of various kinds. This is one of the adjuncts of civilization, as the Indians possess not any cards of native origin. Horseracing for stakes is frequently indulged in by the male members of the tribe. Foot-racing is another kind of sport which seems to have been introduced by the white men. There are many excellent runners among the natives. Occasional foot-races are indulged in by the younger members of the tribe, but these are juvenile forms of sport, which do not account for the speed of the men. A good runner will be able to keep up with a horse day after day, and if the road is winding, will beat the animal by taking advantage of a short cut now and again, and you need not be surprised if the man can get ahead of the brute a mile or two by placing reason against physical endurance.

The days of the arrows with the flint heads have passed away. The arrowheads made from hoops taken from barrels are no longer in use. The flintlock gun of the Hudson Bay régime has been discarded for the Snider rifle and others of later invention. The natives have informed me that they could kill more buffalo with the flint arrowhead than with the rifle because they aimed at the heart of the animal, whereas with the gun they were careless and more excited, and consequently less successful in the hunt. Since the buffalo have disappeared, the zest for hunting has waned, and experts with the rifle are not so numerous as in former years, as they disdain to shoot ducks and prairie chickens, because it is too expensive to use a rifle in shooting them, and should they kill them they will not eat them. Buffalo hunters cannot condescend to shoot small game. Some of the bands of the Blackfeet will not shoot fowl or fish, as they are *taboos*.

The luxury of the camp, the bond of social life, the precursor of treaties, and the adjunct of native religion is smoking. Sometimes a small company of men will assemble in a lodge, and as soon as they are seated the host brings out his pipe with a long stem, and having cut the tobacco and mixed in the *kinni-kinnic*, the pipe is filled and lighted and passed to the end of the line or semi-circle. Half a dozen hearty puffs or more are given, and then one long inhalation, and as he passes the pipestem forward to his neighbor he sends a long stream of smoke through his nostrils. Each member of the group smokes in the same fashion. When the pipe has reached the host, and he has enjoyed his smoke, the pipe is passed along the course it came, and with the stem forward, for there is due formality even in an Indian lodge in the passing of the pipe. When it has reached the first man the same method is followed as before, each smoker taking his hearty whiffs with a final draw and the expulsion of the smoke through his nostrils. As they are smoking for pleasure, and it is not a ceremonial smoke, they indulge freely in conversation during the season of smoking. Their conversation is similar to that of any other group of men gathered for a chat. It may be political, relating to themselves, and then will consist of personal experiences and observations, with arguments drawn from the speaker's study of the question. It may touch upon the affairs of the tribe as affected by other tribes, or the white men and the government in the country. Stories of other days, personal adventures, the battles of the tribe, talks about men and things, the great men of the tribe, the weather, political and social economy, religious observations and the petty gossip of the camp furnish topics for conversation, and as the smoke encircles the heads of the speakers the tongues are loosened, the memory and imagination quickened, and a pleasant hour or two is spent in the lodge on the plains. Twice or three times in ten years did I see a native smoke a small white man's pipe alone, and then it struck me as an important factor in developing the individuality of the man, though I could not help feeling that he was isolating himself from his people, and his modes of thinking were forcing him into new channels which ran alongside the civilization of the white man. When a man smoked alone he used a pipe with a long stem, shorter usually than that employed in company. A woman smoking alone or in a company of women employed a short pipe of the fashion of the white men. A native pipe for women had always a shorter stem and resembled the working or traveling pipe of the men. As in dancing and in feasts the sexes were separated, so also in smoking the same custom was followed; the men and women smoked in distinct groups. Ceremonial smoking was different from smoking for pleasure. Then sacred pipes were used and ceremonial forms induced by their religious beliefs. Around their sacred fire at the Sun Dance the chiefs sat smoking a medicine pipe. Before it was lighted the stem was pointed to the sun and to the four points of the compass, as a sacrifice and an act of worship. At *pow-wows*, due solemnity was given to the occasion by smoking before the talking commenced. The long stem was significant, as in meeting an enemy upon the prairie, when it was held toward him and touched, the two strangers would sit down together and smoke, and their tribal enmity was exchanged for personal friendship. Tobacco was used as a peacemaker, and so strongly did we believe in this medium or token of amalgamation of interests when it was accepted, that during the rebellion of 1888, when reports came to us that some of the peaceful tribes had taken the tobacco sent them by the rebels, we were thrown into consternation.

Guessing with money is a game of the white men, adapted to native conditions. Throwing the wheel is a native game, which the Blackfeet say was taught them by Napio, the Old Man of the Mountains, and for corroboration they will tell you of the rocks in the vicinity of the Crow Nest Pass where Napio himself played the game, and if you are still in doubt you may go there and see them for yourself. A space upon the prairie is marked off from fifteen to eighteen feet long. A board of any length is placed at one end of the course. A couple of arrows and a wheel furnish the whole apparatus for the game. The arrows are those in common use, and since the advent of the white men the heads are made of hoop iron, which are fastened with sinew to the end, the stem being split and the head inserted therein. The wheel is made of wood or iron, and when of the latter material it is the product of the white man's skill. It is usually from four to six inches in diameter, sufficiently heavy to run on the ground over the course when thrown. Strings of sinew ornamented with beads are fastened diametrically on the inside, and upon one of these strings is a colored bead which is the special mark in the game. An equal number of contestants participate in the game; the usual number is two, but I have seen six persons engaged in it, and also instead of one board there have been at various times a board at each end of the course to save time in going from one end to the other. Each of the two contestants holds an arrow in his right hand, the wheel is carried in the right hand, and as they start together running, the wheel is trundled on the ground, and when within a few feet of the board the arrows are thrown against the board, and when they fall the head of the arrow which lies nearest to the bead on the wheel is the winner. The contestant who wins the largest number of runs is the victor and secures the stakes.

The native boys secure much pleasure from throwing clay fastened to the end of sticks, similar to the sport of the white boys. An aboriginal game of the young lads of the camp consists in throwing arrows. The arrows are sharpened at the point and have not any head attached. Walking along the trail from one camp to another, or going in search of horses, or engaged in any pursuit which involves walking or easy running the lads throw their arrows ahead of them, and the arrow which goes farthest or lies nearest to a given point is declared the winner. Men, women and children sport themselves in the water; sometimes both sexes swim in the same part of the river without any clothing. They swim in dog fashion, throwing the hands alternately forward, and as they rise and fall in their progress they allow the water to fill their mouths without swallowing any, and then squirt it with great force. Although they are expert swimmers, they are afraid when in a boat, and men and women will shout with apparent fear in crossing a river. They are more at home on the back of a horse, or holding on to the tail of the animal when crossing a stream, than in the boat of a white man.

Odd and even is a boy's game. One of the lads holds both hands closed palms downward, within one of which is the article hidden, and as he puts forward his hand toward his opponent he sways his body and sings a native song as the gamblers do when engaged in their play. The other lad holds in one of his hands a small piece of wood which he places in the hand where he thinks the article is hidden. If he has guessed rightly, he takes the place of his opponent, and the same operation is gone through until the game is finished.

These various forms of amusement serve to bind the people together by the mingling of the members of the bands, the monotony of the camp is relieved, and the strain of idleness is lessened by driving away dull care and inducing mirth in the lodges on the plains. The games may not be very enlightening, and the paleface may look upon them with a curious eye, yet they are factors in the growth of native civilization which cannot be despised, and are worthy of study as expressions of native modes of life and thought.—American Antiquarian.

German Plows in Porto Rico.—Consul Warner, of Leipzig, April 11, 1901, calls attention to the fact that Germany has been exporting plows to Porto Rico during the past year, and suggests that proper steps be taken by United States manufacturers of agricultural and farming implements to bring their superior products to the attention of the people of that island.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Rubber and Gutta-Percha.—A lecture on rubber and gutta-percha was recently delivered before graduates of the Amsterdam Trade School by Mr. H. A. Berkhout, formerly forester in the Dutch East Indies and now teacher in the agricultural school at Wageningen, Netherlands; from this I paraphrase the following, data remaining intact:

The quality of elasticity and of returning after stretching to its original form distinguishes rubber from gutta-percha, whose form is susceptible of easy permanent change. Both are impervious to water and are bad conductors of electricity. Mixed with carbon and vulcanized by the addition of sulphur, gutta-percha is largely used in the making of telegraph cables as an insulator in which the cables are imbedded. Gutta-percha is the product of one plant, while rubber is derived from over sixty plants. Three-fourths of the gutta-percha commercial product comes from Sumatra and Borneo, although, like tin, it is shipped from Singapore and not from Batavia.

The total world production of rubber may be estimated at 45,000,000 kilogrammes (99,207,000 pounds), of which nearly two-thirds comes from the Amazon Valley, one-third from Central Africa, and one-twentieth from Asia. The exportation from the Indian Archipelago is of slight influence upon the trade of the world. Most of the rubber produced is imported at North American ports. Liverpool imports more than all other European ports combined.

Rubber imports at Amsterdam ranged yearly from 1890 to 1898 from 9 to 34½ tons. Last year, although prices were good for all sorts, the arrivals from the Dutch colonies amounted to only about 17 tons. The importation at Rotterdam has fallen markedly, while at Antwerp it has risen; the fall at Rotterdam from 1890 to 1893 was from 591 tons to 242 tons, while the Antwerp imports rose from 5 tons to 2,014 tons, caused by improved conditions in the Kongo Free State. Rotterdam imports from the east and west coast of Africa fell from 363½ tons in 1894 to 259 tons in 1898.

The cultivation of gutta-percha is not advisable on a large scale, as the tree is grown with difficulty and the native cuts it down to get the product. Gutta-percha is now extracted from the leaves of the tree as well as from the incisions in the trunk. The total production in the world is about one-twentieth that of rubber.—Frank D. Hill, Consul at Amsterdam.

New German Steamship.—The launching of the new North German Lloyd steamer "Kronprinz Wilhelm" at the Vulcan Yards, in Stettin, adds another sea leviathan to Germany's merchant marine. The engineering and mechanical details in brief are as follows: Length over all, 663 feet 4 inches;* beam, 66 feet; molded depth, 43 feet; displacement, loaded, 21,300 tons; measurement, 14,800 registered tons; maximum bunker capacity, 4,550 tons; power, 30,000 horse power; speed, 23 knots; weight at launching, 8,950 tons.

The entire length of the ship is provided with double bottom, divided into twenty-seven water-tight compartments. Seventeen exceptionally strong bulkheads and one longitudinal bulkhead (in the engine room) divide her hull into as many water-tight compartments. Electrical connections with the chart-house show what bulkhead doors are locked or open. The engines will be two quadruple expansion, six cylinders; steam will be supplied from twelve double and four single boilers, capable of working up to 30,000 horse power.

This steamer, in common with all fast German bottoms, is constructed in compliance with certain Admiralty requirements, to increase her adaptability as an armed cruiser in the event of war. Steering gear, reserve steering machinery, and rudder are protected and under waterline.

The ship's accommodation consists of 214 first-class staterooms with 604 berths, 102 second-class cabins with 349 berths, bunks for 702 steerage, in addition to quarters for a crew of 522, making a total of 2,177 that can be berthed and fed.—John E. Kehl, Consul at Stettin.

English vs. American Locomotives in Jamaica.—During 1899 the rolling stock of the Jamaica Railway was in very poor condition. An English railroad expert who was in the island inspecting the service recommended that five new engines be ordered from England, and that as the American engines in use "appeared to have been designed without much regard to the special features of the railway for which they were intended" he would supply the specifications for the new ones, in order to make them specially suited for the "peculiar grades and curves of the railway line."

Among the parties connected with the railroad, the opinion was freely expressed that the United States could not turn out as durable a locomotive as could be obtained in England. Thus the order for the five engines was sent to England.

Two of these engines arrived last month. I append a clipping from the Daily Telegraph of April 1, which gives the result of a trial trip:

"FAILURE OF A NEW RAILWAY ENGINE.

"'No. 27,' one of the two English engines which have just been added to the rolling-stock of the Jamaica Government Railway, failed to give satisfactory results in the second trial trip on Saturday.

"The engine was dispatched from Kingston in the morning in charge of Mr. John Rose, one of the oldest and most experienced drivers on the railway. At Clarendon Park, two cars loaded with coal and five fruit cars, three of which were loaded, were attached to the engine and the test as to the capability of the engine to pull a freight train over Melrose Hill was commenced.

"The train went through Porus all right; but as soon as it had taken the grade in the vicinity of Redberry, the engine began to slow down, and it was noticed that the iron horse could not maintain the proper amount of steam.

"Half a mile away from the foot of the grade, the engine came to a standstill.

"The weather was favorable for the test; but when

* The "Oceanic" is 704 feet long, the "Deutschland" 684 feet, and the "Kaiser Wilhelm der Grosse" is 649 feet long.

additional pressure was put on, the wheels simply revolved without moving the train.

"The engine and the train were brought down on the level line. One of the cars with fruit was disconnected, and a second attempt was made to climb the hill. The engine again stuck at the half-mile mark.

"Another loaded car was removed on the level, and a third trial was made, but with no better result.

"It is understood that alterations will be made to the driving wheels, but some persons are of opinion that the railway authorities will be compelled, in the end, to use the engine only on the level portion of the line."

In an article of the 15th April, it was stated that the engine not only failed to draw the train, but sustained injury in the attempt. The opinion is expressed by people of some experience that, judging by the result of the trial, notwithstanding the alterations to be made, the engines will fall short of what was originally expected.

The grade of the hill over which this locomotive was tested is stated at 1 in 30, and trains of six loaded American freight cars have been regularly drawn over it by the American locomotives.

Increased freight traffic, together with the regular passenger service, kept the United States locomotives constantly employed, and thus did not allow time for them to be properly overhauled and repaired; consequently, it sometimes occurred that in a run of 75 miles—from Port Antonio to Kingston—the engines would lose steam in going over the grades, and two or three stoppages of half an hour or more would result.

Recently, the number of passenger trains has been reduced, and some of the engines have received the long needed repairs. Those that have been overhauled are again performing very satisfactory work.

The American locomotives which have been in use for the past five years are said to have cost a trifle over £2,000—about $9,733.16—each, while the English ones cost a little over £4,000, or about $19,466.32 each. —Nicholas R. Snyder, Commercial Agent at Port Antonio.

Enlargement of Dock Plants at Kiel.—In consequence of the increase of traffic between the North Sea and the Baltic since the opening of the Kaiser Wilhelm Canal, an enlargement of the floating and dry dock plants at Kiel has become a necessity.

The imperial German navy possesses at present at Kiel only one floating dock and four dry docks, which have proven insufficient for the demand; therefore two more dry docks, each of 175 meters (574 feet) length, are in course of construction, so that, in the near future, the navy will own seven docks at Kiel.

The "Howaldtswerke" shipbuilding yard is enlarging its two "Schwentine" docks of 3,000 tons capacity by adding new pontoons, so that the same will in future permit the docking of vessels of as high a burden as 15,000 tons.

The "Germaniawerft," owned by Krupp, is also planning the construction of a floating dock accessible to ships of the largest type.

The necessity of an enlargement of the dock plants at Kiel is clearly proven by the fact that the German first-class battleship "Kaiser Friedrich III," which a few weeks ago was stranded in the Baltic, cannot be repaired at Kiel, as there exists at that port only one dock accessible to this class of vessels; and as the repairs would consume several months, the dock could consequently not be used for other boats. For a similar reason, the new fast cruiser "Askold," built by the "Germaniawerft" for the Russian government, has to be docked at Hamburg, as Kiel does not possess at present a dock of sufficient length.—Hugh Pitcairn, Consul at Hamburg.

Danish Substitute for Rubber.—Consul Freeman sends the following from Copenhagen, April 25, 1901:

This office is deluged with letters from American manufacturers in regard to a report emanating from Bergen, Norway, to the effect that a chemist of Copenhagen had discovered a process for manufacturing out of asphalt a material called "solicum," which serves as a substitute for rubber. No process has been patented or discovered in Denmark for manufacturing such a material out of asphalt. A chemist named C. A. R. Steenstrup has recently patented a process for making solicum from old rubber and oil. Its efficiency as a substitute for pure rubber has yet to be demonstrated.

Destruction of Phylloxera in Germany.—Under date of April 12, 1901, Consul-General Guenther, of Frankfort, informs the Department that prominent German Government officials and scientists, in discussing the different methods suggested for destroying phylloxera on grapes, decided that the only known means of accomplishing the result effectually was by the use of bisulphuret of carbon and petroleum.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1041. May 20.—*Teak Industry in Siam.—Unfavorable Crop Prospects in Germany.

No. 1042. May 21.—German Meat-Prohibition Law.—Railway Subsidies in Canada.—Salmon Fisheries in British Columbia.—Japanese Investments of Capital.—Trade Notes from Honduras.—*Destruction of Phylloxera in Germany.—Telegraph Wires Laid on Snow.

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No. 1045. May 24.—*American Manufactured Products in Germany.—*German Wine-Trade Directory.

No. 1046. May 25.—United States Preserves in Germany.—Alcohol vs. Coal in Germany.—Belgian Government Savings Bank.—Furniture in Southern Germany.—New Commercial School at Cologne.—*Danish Substitute for Rubber.—*Combination of Scandinavian Match Factories.—*Dock at Corinto.

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